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AMERICAN POTASH INSTITUTE, INC.

INVESTMENT BUILDING **WASHINGTON, D. C.**

Better Crops with PLANT FOOD

The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*

Editorial Office: Investment Bldg., Washington, D. C.

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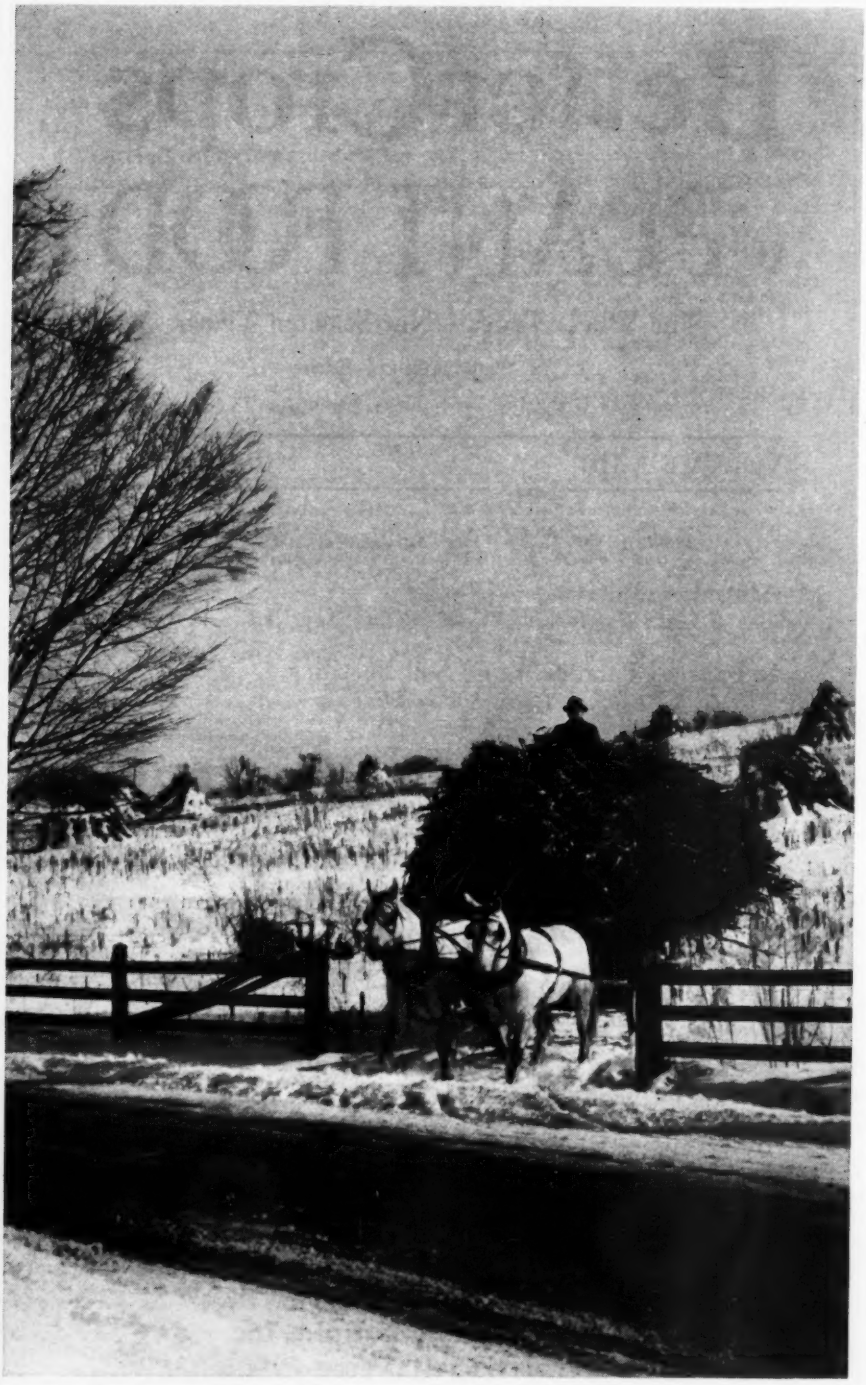

Difficulties Attend Belated Haulings

Better Crops with PLANT FOOD

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VOL. XXIII WASHINGTON, D. C., NOVEMBER 1939 No. 9

Faith in our continued—

Abundance

By Jeff McDermid

WE HAVE so much abundance in my State that we expect to celebrate two Thanksgivings, one set by the New Deal president and the other by the Square Meal governor. Although they were elected on opposing party tickets, this circumstance apparently has little to do with their rival proclamations. A few of us look with suspicion on the turkey growers and cranberry merchants who may have conspired to encourage such lavish plans for the feast day. Yet as a measure for enhancing party popularity in the coming generation of voters, I have no doubt the establishment of two school holidays amid plenty of delectable viands will earn the sponsors the support of countless small boys.

Neither have I the remotest misgivings about any repetition of a day of thanks over a land of abundance. It may cause qualms to housewives over bellies and budgets, and likewise unsettle sundry heavy feeders. Those whose duty consists in either providing a balanced meal or absorbing one afterward may face problems. It may cause a run on the groceries almost amounting to another hoarding urge, and it is bound to deplete our corner drug store of ex-lax and bicarbonate of soda beyond the normal November tonnage.

It may drive ministers and essay writers to devilish extremes in thinking up new preachments for old texts. At any rate, it will give us twice the num-

ber of touchdowns for Thanksgiving and perhaps bring us a little nearer to the desirable goal of being more frequently aware of countless benefits we enjoy and American advantages we overlook.

For surely a State with two bona fide, officially sealed Thanksgivings and plenty of contrasting misery in large doses coming to us in European dispatches has a chance to let the spirit of gratefulness sink in a trifle deeper than it has before. Instead of quarreling with each other over whether we should feed the unemployed, we may all rejoice together that we have enough provender for worker and drone alike to spread out in peaceful surroundings. I surely believe we are going to realize what Thanksgiving means this year to the fullest degree.

IN FACT, I even doubt if Cap John Smith or Governor Winthrop (or whoever it was who dodged the most Injuns to reach for his pumpkin pie) could have sensed the value of a peaceful mouthful any more than we do at this period.

In those quaint days the word "submarine" could have meant only sunken treasure left by the buccaneers or something finny to go fishing for. A good runner could beat a gun shot, and the only things men feared from the air were swamp mosquitoes and an irate wife's kitchen utensils. Of course when they fought each other it was done in the "grand manner" with everything open and on the carpet like tugs-o'-war and wrestling matches. He who could gouge the most eyes, bulge the biggest biceps, and sock hardest with the loudest grunts was in the best position to propose an armistice. Thus the statesmen of those times fully banked on rough and tumble struggles and open door diplomacy. They would open it with prayer and finish it with a marlinespike.

He who called for an exchange of notes was only postponing his funeral procession. It was just as easy to die in those days on the so-called field of honor, but folks seemed to know what they were scrapping about and presumably they got what they wanted, if our American resources are any safe indication of their prime objective. But our forefathers fought for other things than victuals, and in this regard it should be our Thanksgiving duty to prod ourselves to find out if we really treasure such items of less material kind as much as we ought.

NATURE in our best and most favored localities has usually been lavish to prodigality. But in the wilderness days man took what he could get for the grabbing, and that made him forget the debt he owed to his community and his soil. It is only when man joins nature's forces at the plow handles to reinforce and augment their power that he assumes his proper share of responsibility and realizes the full joy of well-earned harvests.

To such provident folks the juice of roasted pippins and popcorn at the fireside carries more tang and zest than otherwise. One can dilate on the quality, the aroma, and the yield and feel a tingle of pleasure at being a contributing factor in producing abundant food. One can argue over cultural details and become superheated over methods, which after all are the real delight of him who garners in the gifts of the soil in which the mind of man has played a part. Of what good is it to reach out and pluck the fruit wherein no sacrifice and labor have been expended by cooperative effort?

IF ON THE other hand the farmer lags and loafs and never learns or profits by his own and other's errors, he then most likely blames the government or cusses the soil for its lack of fecundity. Thanksgivings, single or double, would have no meaning to such misanthropes. Such harvest celebrations might as well be erased as far as he is concerned.

America has had and I presume it will always have these contrasting kinds of partners with nature. These shiftless

ones are not much in evidence at Thanksgiving observance, they are too busy hanging up their socks for Christmas, if the Board of Health will let them.

Soil fertility balance and livestock farming as its companion objective have been talked in our realm for many long, and some folks say, for many futile years. Our college station circulars have published proof enough and successful operators have furnished evidence galore that he who attends to the larder below the ground where the microbes and invisible organisms replenish the subsoil resources is banking ahead for his old age.

I sometimes think we may have failed to decorate our bulletins enough with wise saws and modern quips, or else have not jazzed them up to suit the avid eyes of sensation seekers. Maybe we have crowded into them more six-point tables and dreary "conclusions" couched in technical language than the ordinary work-a-day mind can easily absorb and enjoy. But the root of the trouble lies in inertia and a combination of the get-rich-quick and hand-out doctrines, both of which are a veritable wet blanket on spontaneous acceptance and adoption of soil management principles.

THIS question is a very complex and challenging one, and its solution varies widely in our vast country of hundreds of soil types and soil series. I sometimes think as a layman that we spend too much on work and demonstrations that mine the soil rather than on real research to fit the needs of regional replenishment, followed by extension work to secure more acceptance. Anyhow as I sharpen my teeth for the turkey bones, I fail to see how anyone can face the Thanksgiving without deeper cognizance of the basic values lying locked up in the frozen clods out there afield which winter is closing down for a six-months rest. Otherwise we sit like Nebuchadnezzar in a rueful feast where the scales are visibly weighted against us.

It is just one more of those domestic problems which large armaments and talk of war scare will not subdue or solve. It is just another of those internal sore spots that cry out to be healed while we are away looking for a surgeon to operate on our neighbors.

I suppose the time is coming, if indeed it has not already arrived, when we will want to decide whether to spend our public funds mostly on saving or restoring old barren wastes or developing deserts, or whether to exert some new and hitherto unfound way to fatten all the acres lying within our best agricultural empire to a state of fertility closely approaching that which the pioneers and ox teams discovered a century ago. Probably if we succeeded in the latter venture we would have enough groceries to keep us in a satisfying surplus muddle, to say nothing of efforts to reach out and reclaim the untouched arable. But in all such policies we must account for the man on the land and his destiny, as well as the health of the soil. That brings us back to the mooted problem of what we need most, more chances to farm well by a few or more chances to "farm at it" by the many. If mere subsistence is sought, then our course is relatively simple compared to what we must perform if a satisfying income is required for an expanding farm personnel.

Or can we attain both objectives well? No doubt we can, if we agree to devote some portion of our public money to a questionable subsidy, on the grounds of human engineering rather than dollars and cents return. It may be sounder and saner to subsidize doubtful soil re-

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It Pays to Balance Your Soil Fertility

By C. J. Chapman

Department of Soils, Wisconsin College of Agriculture, Madison, Wisconsin

MAN "lives, moves, and has his being" in a world full of unseen but powerful forces for good. He has been endowed with an intellect which has enabled him to harness the forces of nature and make them work for him. Science in agriculture is working miracles, and it behooves all of us to learn more of the mysteries of nature and apply the findings of science in so far as they may have an influence on our well-being and add to our prosperity and happiness. And so we are digging out of the earth stores of concentrated plant food. We are fixing the elements of the air in great factories, using these compounds in the form of commercial fertilizers to restore the productiveness of our worn and depleted soils.

In Wisconsin, farm manures have always been depended upon as the chief source of plant food in the maintenance of fertility; yet we are coming to recognize the fact that stable manure is not a balanced plant food. Further, we are learning that plant food is being sold from our farms in the form of dairy products, livestock, and cash crops—that even in a system of livestock farming where all crops are fed and the manure produced returned to our fields, we are losing fertility at an alarming rate. In order to maintain the productiveness of our soils, in order to grow the big crops so necessary for economical production, we are finding it necessary to balance our soil fertility with commercial plant foods.

A fertiliser demonstration on the John Hildebrand farm at Cross Plains gave conclusive proof that potash was needed on this Waukesha silt loam soil.

Treatment	*Yield per Acre*	*Increase*
No fertilizer	23.4 bu.	
0-20-0 at 200 lb.	29.3 "	5.9 bu.
0-20-10 at 200 lb.	49.3 "	25.9 "

Information as to the kinds and amounts of fertilizer to use may be secured by the testing of soil samples. Information may also be obtained through the general recommendations contained in

bulletins from our Agricultural Experiment Stations.

There is a widespread interest in soil testing. In Wisconsin we have set up county laboratories in most of the counties in the State. Hundreds of thousands of soil samples are being tested in an effort to determine the kinds and amounts of fertilizer needed for the particular crops to be grown. Certainly it is true that the testing of soil samples, together with a knowledge of the general requirements of our various soil types, a knowledge of the crop to be grown, and something of the crop history of the field, does enable us to make our recommendations with a fair degree of accuracy.

Renewed Interest in Soils

Farmers are coming to recognize the fact that the repair of their soils is just as important as the repair of fences, buildings, machinery, and equipment. In fact, there is a wave of interest sweeping across this country in matters pertaining to soil conservation and the restoration of soil fertility. Speaking of this growing interest in soil conservation, Secretary of Agriculture Henry Wallace makes this statement: "As never before this Nation has awakened to the need of stopping the exploitation of our greatest national asset—the soil. Soil conservation is the last line of defense against national suicide, and that defense must go on."

The parable of the man who built his house on the sand is well illustrated in the farmer who spends his money for fine equipment, fine buildings, machinery, and blooded livestock, who will have his fine automobile, radio, and other luxuries, but who does not make any provisions for the repair of his soils and maintenance of soil fertility. Disaster and eventual ruin will come to farmers and all others who live by the philosophy of "eat, drink, and be merry and let the morrow take care of itself."

If we were spending our money ten times as fast as we were making it, we would not last long, would we? But that is exactly what is happening on our Wisconsin farms. We are drawing checks on our bank account—the soil—and spending our soil fertility ten times as fast as we have been replacing it with fertilizers. We have been short changing our fields in the return of stable manure, thinking that we were actually keeping up soil fertility. But unavoidable losses of plant-food elements have occurred in the feeding transaction, and the subsequent waste of fertility in the handling of stable manure. In fact, in Wisconsin this loss of plant food amounts to better than $30,000,000 worth each year. The 46,000 tons of commercial fertilizer used by Wisconsin

On the Anthony Schroeder farm near Middleton, Wisconsin, residual benefits from 0-20-10 fertilizer applied at 250 lb. per acre to oats in 1938 resulted in an increase of 1½ tons of alfalfa hay in 1939. The increase in the yield of oats in 1938 was more than 16 bushels. The total value of grain, straw, and hay increases amounted to $19.09 per acre over and above the cost of the 0-20-10 fertilizer. The soil was Miami silt loam of low fertility.

farmers last year are only about 10% of the amount of plant food needed to balance our annual soil fertility budget. And this thing has been going on year after year for the past 50, yes even 90 years, in the southern half of Wisconsin.

We still hear the argument that we are producing too much now. Why use commercial fertilizers and still further increase production? But that farmer would be a fool who would sell his best cows because they were producing too much milk, or take away the bran and alfalfa from his cows in order to cut production. He would be a foolish man to permit his best fields to lie idle and cultivate only the poor land on his farm. He would be foolish to let his manure lie in the barnyard and thus lower the yields on his farm crops in order to cut down production.

Urged Improved Practices

The Federal Government, of course, during these past 6 years has made a stupendous effort to regulate production, to control acreage, so that we would not be faced with enormous surpluses; has further paid out millions of dollars to farmers in an effort to induce them to follow out approved crop- and soil-management practices. But I have always argued that it is more profitable to grow 10 acres of potatoes, yielding 300 bushels per acre, than to grow 20 acres yielding only 150 bushels. I have argued that farmers would be better off if they seeded down from 25 to 30% of their poorer land and let it grow to grass than to devote these acres to the growing of crops, making poor yields which are invariably grown at a loss. Our surpluses for the most part have been produced on marginal land that should and is being taken out of production.

The final argument which I present in my advocacy of soil fertilization and conservation is that it will pay a farmer to fertilize and lime his soils. If a farmer can recover his fertilizer dollar with a good rate of interest, if he can invest a dollar and get two to three dollars return on the investment, that is good business. If some security house or bank advertised bonds or other securities that would mature in 3 or 4 years and pay 100% interest, there would be a wild scramble by investors to purchase such securities. But here I am talking about investments that will pay 100, 200, and even 300% interest.

Soil-building for Profit

What evidence do we have to back up these arguments? Let me illustrate with the case of William Wagner, Middleton, Wisconsin, who bought a 200-acre farm some 20 years ago and paid $40,000 for it. He had very little money to pay down on the farm at the time of purchase. However, in a period of 20 years Mr. Wagner has not only paid for this farm in full, but has made improvements amounting to better than $10,000. But Bill Wagner is a good farmer. In the early days he started in on a soil-building program. He has limed every acre of his farm. A good herd of dairy cows, good crops of corn, plenty of alfalfa, hogs (from 100 to 150 hogs each year), coupled with good management and plenty of hard work have been the secret of his success. He has followed through on a soil-improvement program. This year (1939) Mr. Wagner used fertilizer on all of his small grain. We conducted a demonstration on his farm in order to determine what fertilizer combinations were best adapted to his soil. The crop was barley, and all treatments made a good profit. However, the mixtures carrying potash made increases way ahead of the straight phosphate. Yields are given in the following table:

Of course, the residual benefit of the fertilizer treatments to the hay crop in 1940 will add further to the profit from the fertilizers used.

I could cite a hundred such illustrations where farmers have been using fertilizers with profit. But I wish to present further evidence from actual field demonstrations to prove that by and large our soils are responding profitably to fertilizer treatment.

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This fine looking field of celery was grown on muck soil near Oviedo, Florida.

Florida Studies Celery Plant-food Needs

By J. Francis Cooper

Editor, Agricultural Experiment Station, Gainesville, Florida

THE "big freeze" of 1895, together with another severe cold in 1899, put Florida in the business of celery production. Many citrus growers in the northern half of the peninsula who had their trees killed back in '95 started new groves immediately. When the cold of 4 years later nipped their young trees, they turned their attention to vegetables, and it was found that the Sanford area in Seminole County was particulary adapted to celery. This crop has remained important around Sanford and Oviedo for 40 years, has become important in Sarasota and Manatee Counties on the West Coast, and is beginning to assume a place of prominence in the Florida Everglades.

Growers around Sanford had artesian water available, and their surface soils, mostly Leon sands, were underlain at 2 or 3 feet with a hardpan layer which was quite impervious. This situation was practically made to order for subirrigation, which is extensively practiced there. Terra-cotta pipe lines with open

joints are laid at convenient intervals across the fields, and water is turned in through them. The hardpan layer prevents the water from going down, so it can be made to rise to whatever depth is desired.

Celery a Heavy Feeder

Celery is a winter and early spring crop in Florida, requiring from 80 to 120 days in the field. Seedbeds near Sanford are planted beginning in July, and the plants are set to the fields from September to February. Harvesting begins usually around the last of January and continues until late April or early May.

Celery, being a leaf crop of high yields per acre, is a gross feeder. Seminole County growers have been using from 3 to 5 tons of fertilizer per acre, but with evil days of recent years falling on their industry, many growers have cut down the amount to 2 tons per acre. Some of them are finding the more economical lower rates of application satisfactory.

Dr. R. W. Ruprecht, chemist in charge of the Florida Experiment Station's celery laboratory at Sanford, says most Seminole growers use a 4-5-5 fertilizer, with a few using a 5-2-8, and some others insisting on an even higher potash content. Most of them prefer half of their nitrogen from organic and half from inorganic sources. Generally, the Seminole growers apply from 500 to 1,000 pounds of their fertilizer in the furrow before planting and from 500 to 1,000 pounds at 10- to 14-day intervals after the plants are set. Most growers top-dress once or twice with nitrate of soda or nitrate of soda-potash (12-12) shortly before the plants are to be harvested.

In addition to the regular fertilizer elements, most growers around Sanford apply borax to prevent the development of cracked stem, a trouble which harassed the industry for years before the Experiment Station's celery laboratory discovered that it was due to a deficiency of boron in the soil. The laboratory recommends annual applications of 10 pounds of borax per year, and states that larger applications are apt to be distinctly harmful. The borax dis-

When properly fertilized, peat and muck soil in Florida will produce quality "celery."

solved in water is applied as a spray shortly after the plants are set.

The Florida Everglades, with its vast acreage of muck soils, is forging rapidly to the front as a celery-producing area, even though it is as yet a small producer in comparison with other areas. The first celery in quantities sufficient for carload shipments was planted there about 1928. However, it was not until the 1933-34 season that any real expansion of celery acreage occurred. During that season Palm Beach County shipped 54 cars of celery; during the 1937-38 season the number jumped to 347 cars; in 1938-39 it harvested 600 acres. The acreage for 1939-40 is expected to increase 50 per cent to 900 acres.

Both soil type and climate in the Everglades seem entirely suited to celery production. Both peats and mucks will grow celery to advantage, but most of the muck soils near the edge of Lake Okeechobee are utilized for more tender crops, so that celery is grown largely on the sawgrass peats. This peat is organic in nature, the soil acts as a huge sponge, with high water-holding capacity, adequate pore space for soil air, and a fine capacity for holding plant foods applied as fertilizers. Satisfactory fertilizer applications on the peat can consist of smaller quantities than on the highly mineral soils.

Water Control Necessary

The peat and muck soils, formerly overflowed lowlands, have been made available to cultivation through drainage of the Everglades. In recent years it has been amply demonstrated that water control is quite as important as drainage—simply taking the water off the land may leave the muck too dry for crops to grow, or even may cause it to dry to the extent that it will burn readily and be lost in case fire gets started. (Fires have ravaged thousands of acres, and State officials estimate that they have done $40,000,000 worth of damage to the peat soils in recent years.)

Wherever possible landowners now

Dr. R. W. Ruprecht, left, of the Experimental Celery Laboratory at Sanford, inspects some celery with County Agent C. R. Dawson.

control the water level by pumping water from drainage canals into their drainage ditches, which serve equally well as irrigation ditches, the land being so flat that the water will flow either way. Most growers now run mole lines from one irrigation ditch to another at regular intervals, usually about 20 to 30 feet apart. These mole lines are made by a heavy machine with a narrow foot, on the bottom of which is the torpedo-shaped "mole." The narrow foot cuts through the loose soil, and the "mole" leaves a small open line through which water movement is facilitated.

Through the use of mole lines and ditches, the water table can be held at any desired level. For celery, except in the seedbed and when the plants are being set to the field, the best level for the water table has been found to be 16 to 24 inches.

While peat and muck soils are high in nitrogen, they are almost universally deficient in phosphate and potash. In southern Florida a goodly number of the soils are lacking also in copper, manganese, and zinc.

In an effort to develop information relative to best fertilizers for celery in the Everglades, Dr. Joseph R. Beckenbach, formerly of the Everglades Experiment Station and now of the vegetable

laboratory at Bradenton, has conducted some fertility tests covering a period of several years and a considerable acreage. Standard commercial cultural methods were used, the plants set in single rows 30 inches apart and 4 inches apart in the row, giving approximately 52,275 plants per acre. A regular spray program was followed.

Despite the fact that peat soils are highly nitrogenous in nature, celery in Dr. Beckenbach's tests at and near the Everglades Experiment Station responded to nitrate fertilizers each year.

Florida celery is harvested in from 80 to 120 days after it is set in the field.

Over 5 years the average annual yield was increased by 75 field crates per acre where nitrate fertilizers were used. Mineral nitrates seemed as satisfactory as organics, and a mixture of half nitrate of soda and half sulfate of ammonia seemed to be entirely satisfactory and economical.

Peat soils are very low in potassium, and Dr. Beckenbach obtained marked response to applications of this element, celery grown without potash being virtually a failure on those soils. With mixtures analyzing 12 per cent potash, yields ranged more than 500 field crates per acre. Higher analyses gave slightly higher yields, but did not always prove profitable.

Dr. Beckenbach tested four sources of potash—sulfate, muriate, kainit, and hardwood ashes. All were satisfactory except the kainit, but ashes were entirely too expensive. Muriate of potash plots outyielded sulfate of potash plots in 7 out of 10 comparisons, and the muriate, being more economical, is recommended.

Five different sources of phosphoric acid were compared—16 per cent superphosphate, colloidal phosphate, floats, foreign basic slag, and domestic basic slag. Floats and colloidal phosphate were found to be definitely unsatisfactory, regardless of cost. The other materials all were more or less satisfactory, the domestic basic slag in particular showing up well. Since basic slag contains from 1 to 3 per cent manganese oxides, this material seems especially adapted to unburned peat soils. (Of course, ammonia fertilizers should not be mixed with basic slags.)

Fertilizer Recommendations

After considering results on all plots over a period of 5 years, Dr. Beckenbach is convinced that a fertilizer analyzing 3-6-12 is most desirable and profitable for celery on Everglades soils. Broadcast applications gave responses equal to or better than those made in bands under the plants, and were less apt to burn. Celery roots make a tremendous spread of growth and thus are able to utilize fertilizer applied broadcast, either by hand or with a seed drill. All of the fertilizer can be applied before the plants are set.

The rate of application is dependent on previous treatment of the soil, and on whether celery strippings are left on the soil. On virgin land, which Dr. Beckenbach recommends be turned a year before celery is set on it, 2 tons per acre of a 3-6-6 or 3-6-12 are satisfactory. With land previously cropped and fertilized for crops other than celery, he recommends the same quantity. When strippings are left in the field and celery grown on the land in succeeding years, 1 ton per acre of a 3-6-12 has proven

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Ingenuity Employed In Official Research

By C. B. Sherman

United States Department of Agriculture, Washington, D. C.

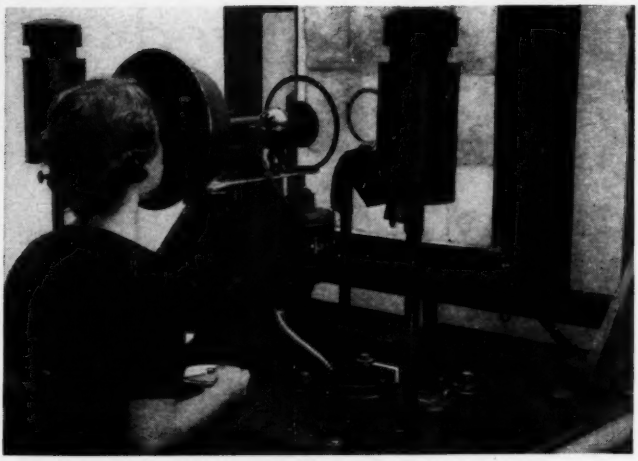
ONE little-publicized means of improving our crops and of ascertaining just how good our crops are when they reach the markets is unusual in its essence. It is the ingenuity displayed by the improvement and standardization workers. When they find themselves up against a total lack of method or instrument to accomplish a needed result or make a needed measure, they apply themselves to working out, designing, or inventing the appliance or method that will do the job. Or sometimes the equipment or method in use seems too slow and cumbersome. Then they set to work to make it more rapid and practicable. They improve it sometimes beyond recognition.

It cannot be claimed, of course, that all of these workers are gifted with the inventive sense, but a surprising number have demonstrated its possession to some degree. The results have greatly increased the possibilities of the standardization research and the services offered by the U. S. Department of Agriculture, and they have given practical effect to the research effort and to the technical method of approach.

No one has ever been able to define quality in cotton scientifically, nor to measure it accurately (although there has always been plenty of talk about cotton quality), partly because we lacked the precision equipment with which to find out and to measure. But piece by piece such apparatus is being developed, invented, or improved. Apparently, we are well along now on the march towards providing such needed new equipment all along the line, from the gins, through the fiber laboratories, and in the classing rooms.

Ginning can ruin cotton quality or it can seem to enhance quality by some of its procedures, as drying and cleaning. Right here we begin to find some of these Government inventions. These

A permanent identification tag is installed in a bale of cotton while it is in the press box.



Miss Dorothy Niekerson measures the color in a box of cotton standards by means of equipment, part of which she improved and patented.

are connected with the experimental gin and ginning laboratories at Stoneville, Mississippi.

It is important to know precisely whether seed cotton needs drying and, if so, how much and under what conditions. Application has been made for a public-service patent on a moisture indicator for use on seed cotton. This hygrometer determines the moisture better than previous methods, and the work can be done in only a few minutes compared with five or six hours needed for the oven tests. Now a number of horizontal and vertical types of driers have been developed by the Department engineers and patented in the name of the public. The aim has always been to increase drying efficiency and to decrease the cost of installation and of operation.

Patent application has also been filed for a pressure-delivery method of feeding seed cotton from the bottom of a drying tower to a separator instead of discharging cotton by gravity to a clearner, or handling it pneumatically. Public-service patents are also pending for the wye system of feeding cotton driers and for a pressure feed for pneumatic ginning systems.

Many other devices and methods have been developed to improve ginning results, for which patents have not been requested. They include such technical contrivances as a special cotton-ginning stroboscope, a gauge to test the airblast pressure in gins, a device for controlling the air volume, a rib gauge for ascertaining the distance between gin ribs and the wear and tear on them, and an air-blast-nozzle width gauge. There is a story back of each of these developments, but it is enough to say here that they are of especial use to cotton gin specialists in the extension activities which now recognize that if we are to put better cotton on the markets, it is as important to work with the ginners as with the cotton farmers.

Perhaps the greatest care has been taken in every part of the preparation of the cotton at the gin. Then almost at once in the marketing channels the identity of the bale is lost. This fact has caused the Department of Agriculture concern for many years. It should be possible to trace a fine bale to its source and to find where the occasional fraudulent bale comes from.

After experimenting several years with different methods, the Department workers have now patented a wire cotton bale-tie and a permanent cotton-bale identification tag. The tag, which consists of a metal tag-head and a wire anchoring device, is installed while the bale is being formed in the gin press-box. These tags, which in tests have withstood fire that consumed the bales, are now being used experimentally in commerce and eventually will probably be used to advantage in the cotton trade.

Then comes the question of sampling.

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Renovation Makes Pastures Profitable

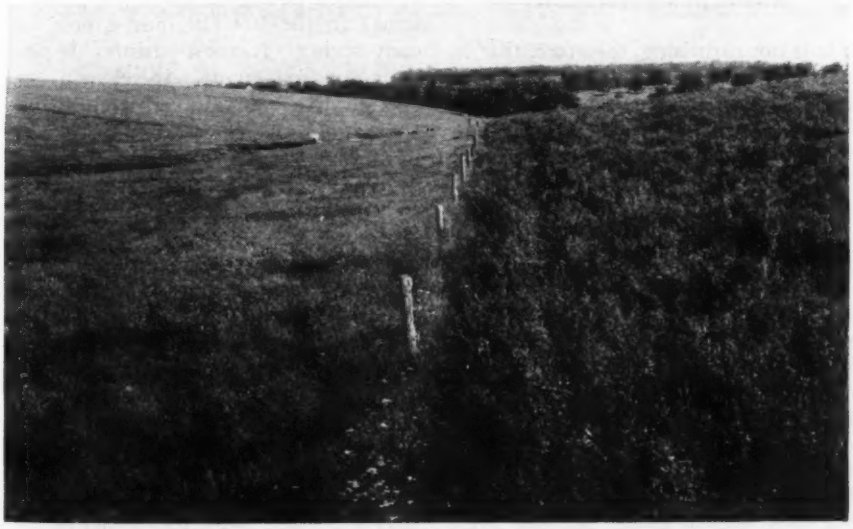
By F. V. Burcalow

Wisconsin College of Agriculture, Madison, Wisconsin

"TAKE care of the legumes and the grasses will take care of themselves" is axiomatic in grassland management throughout the humid areas of the world. Reciprocity finds no better illustration in the whole plant kingdom than the associated growths of desirable grasses and desirable legumes. The legumes furnish nitrogen and organic matter for the grasses, and the grasses supply shelter for the legumes.

White clover (*Trifolium repens*) is the premier legume for growth in association with the most desirable grasses where rainfall is abundant and well distributed, winter injury is not a serious problem, the growing season is characterized by cool weather, and soils are rich in humus and mineral nutrients. Physiologically and morphologically it is the ideal pasture legume under such conditions. When grazing is properly regulated, undue competition of the grasses is held in abeyance, and the survival and productivity of white clover are assured. This is a rather well-known fact.

What is not so generally known is that farmers of the north central States are solving the chronic problems of dry summer weather with legumes whose heat and drought endurance is far superior to white clover. Moreover, such legumes are being established in blue-



Renovation with sweet clover (right) provided succulent grazing during summer drought when bluegrass was dry and unpalatable. Photo, courtesy S. C. S.

grass sods without plowing, without erosion, without the destruction of the grasses, and with benefits that are truly amazing. Not only is the carrying capacity of such pastures often doubled and trebled, and not only is succulent grazing provided during summer drought, but weeds are greatly reduced and damage from that major pest of the many grassland areas, the white grub, is practically eliminated. Such benefits do not prevail just for 1 or 2 years, but for several. This plan of grassland improvement was developed at the Wisconsin Experiment Station by L. F. Graber, and it is known as renovation.

Where periodic drought and heat prevail, white clover is sporadic and irregular in its contributions to the grasslands of humid regions. Granted that the soil is well supplied with potash, phosphates, and lime—the prime essentials for its welfare—white clover may persist, but it will only be productive if nature favors it with abundant, well-distributed rainfall and accompanying cool temperatures. It is not a dry-weather legume, nor is it a hot-weather legume. It is a surface feeder, and it is heir to the many ills of climatic adversity.

Alfalfa and Sweet Clover

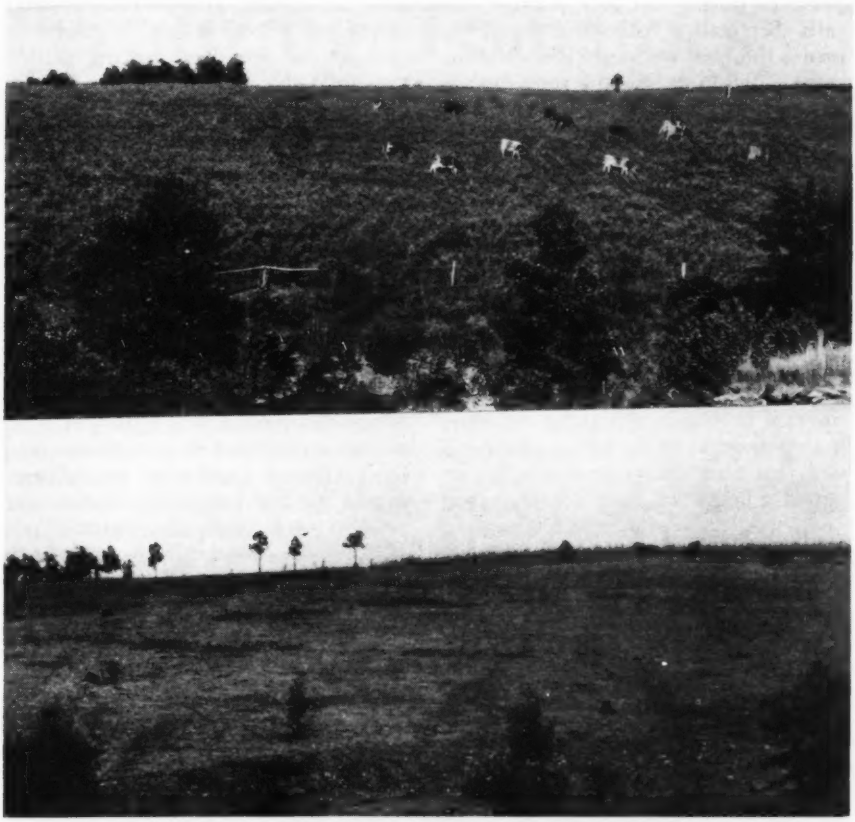
It is not surprising, therefore, that in the Midwest where extended periods of dry hot weather are not uncommon, farmers look to such heat-resisting and drought-enduring legumes as sweet clover and alfalfa to furnish succulent pasturage when bluegrass and white clover are "siestic," dormant, and waiting for moisture to revive them.

In the major drought years of 1934 and 1936 when grasses and white clover were browned and shrivelled to the kindling point, properly managed sweet clover was tall, productive, green, and succulent, and alfalfa was not far from it in performance under the stress of such environmental adversity. No wonder, then that farmers have been growing their regular fields, biennial sweet clover and alfalfa as dry-hot-weather supplements in their grazing set-ups. No wonder, that more recently with the findings of agronomic research, they have begun to establish sweet clover, or a mixture of sweet clover and red clover, and alfalfa, or a mixture of alfalfa and red clover, in unproductive permanent bluegrass pasture sods without plowing. The practice is "taking hold" in Wisconsin and elsewhere with a remarkable degree of success. It is one of the "must" practices of many cooperators with the Wisconsin Soil Conservation Service.

Old Pastures Need Help

Renovation is a first-aid treatment to grub-damaged or poor, unproductive, weedy, nitrogen-phosphate-potash-lime deficient, run-down permanent grasslands. Many of such pastures are hilly, and the soil is erodible. Plowing is hazardous and sometimes impossible. But such pasture sods can be scarified with a disk or spring-tooth harrow or both. With these implements and a drag a satisfactory seedbed can be prepared during periods when the soil contains the right amount of moisture to work up well. If weeds and old grass or other residues interfere, they can be burned off (using the usual fire precautions) in the late fall, mid-winter, or early spring. In most pastures despite their unproductivity, there will be enough live roots and rhizomes and enough old sod incorporated in the soil to prevent erosion. The grasses are not killed, but, of course, they are weakened sufficiently to get dry-weather legumes started.

The needs of sweet clover, alfalfa, and red clover for lime, phosphate, and potash are too well known to warrant discussion. Soils deficient in one or all of them will never sustain productive growths of dry-weather legumes, and seedings are doomed to failure unless the soil needs are ascertained by soil tests and adjusted by proper applications of these essentials. Lime and fertilizer may be applied to the sods either before or during the scarification process. They



Below is a typically run-down, grub-injured bluegrass pasture with a very low carrying capacity. After renovation (above) with sweet clover, the productivity and density of the bluegrass were restored and white grubs and weeds, the two common pasture pests of the region, were practically eliminated. Photo, courtesy S. C. S.

should always be incorporated in the surface layer of the soil.

Many unproductive pastures are characterized by abundant growths of weeds, such as the ragweed, horseweed, and others. Because they form seed annually, enormous populations of weed seeds have accumulated in the soil and they may afford destructive competition for the young seedlings of dry-weather legumes. Such situations are handled effectively by repeated diskings or other cultivations at intervals of from 1 to 3 weeks, and deferring the seeding until the end of May or the forepart of June. In regions where August or September seedings are feasible, the weed problem is not difficult, since the dry-weather legumes become well established during a period when weeds are for the most part dormant and inactive. The dry-weather legumes are sown in the scarified grass sods in the same manner as they are sown in cultivated fields, but at rates 2 to 4 pounds heavier than normal. A nurse crop of grain is used only when the soil is so devoid of sods that erosion becomes hazardous.

Obviously grazing needs to be withheld from the area of a pasture being renovated until the dry-weather legume seedlings are well established, and consequently this portion of the pasture must be fenced. However, when the legumes are well rooted and have abundant top growth (usually in July with spring-sown sweet clover, alfalfa, and red clover) moderate grazing can be

practiced during late July, August, and early September without seriously injuring the new seeding. With the oncome of fall rains, grazing should cease, thus giving the young legume plants an opportunity to prepare for winter.

After dry-weather legumes have been successfully established, the benefits of this renovating treatment are largely dependent upon regulation of the grazing, and this is rather easily accomplished since the renovated area is already fenced. Excessive grazing is extremely harmful to both the legumes and the grasses. A very desirable plan of grazing areas renovated with sweet clover is to pasture closely for not more than two weeks in the spring of the second year after the sweet clover has attained a height of from 2 to 3 inches. The subsequent growth of the sweet clover and grasses is held in reserve to provide for succulent grazing during the usual dry period of July, August, and early September. Alfalfa is very sensitive to early defoliation, and grazing is often held in abeyance until blossoming or later.

Because it is widely known for its soil-enriching qualities, its great drought and heat resistance, and its aggressive growth, and because of low seed costs, biennial sweet clover (especially in mixture with medium or mammoth red clover) is being widely utilized for the renovation of permanent grasslands. When the second year's growth is so grazed as to permit seed formation, and the associated grasses are grazed very closely for the remainder of the year after the sweet clover seed has formed, it is not at all uncommon for a new stand of sweet clover to arise in renovated pastures in the third year. With regulated grazing, good stands will persist and will produce seed again in the fourth year, until the grass sod becomes so dense that seedling plants find it difficult to establish themselves.

Lifted like a mat from the floor, this old bluegrass sod, like many others, has been victimized by white grubs which prevailed at the rate of from 200,000 to 300,000 per acre. Such damage is eliminated by renovation, since sweet clover and alfalfa repel the egg-laying of the June beetles. Grub-damaged pastures are easily scarified and renovated with dry-weather legumes.

In the famous bluegrass region of southwestern Wisconsin, 4 acres of an unproductive weedy pasture on a steep hillside were renovated with biennial sweet clover, and a smaller area with alfalfa in 1929. It was Graber's first attempt to ascertain the practicality of renovation, outside of the trials he had conducted previously for 4 years on the University Farm at Madison. Not only was this venture a remark-

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Fertilizing Tomatoes In Eastern Virginia

By E. R. Purvis & J. M. Blume

Virginia Truck Experiment Station, Norfolk, Virginia

ALONG the tidal streams and coastal estuaries of eastern Virginia are located the oldest agricultural soils of the United States from the standpoint of number of years of continuous cultivation. Spreading radially from Jamestown, the earliest English settlers planted their corn and tobacco over large areas of the well-drained, sandy Coastal Plain soils early in the 17th century. Some of these soils have been in continuous cultivation since that time.

The soils of this area are predominantly of the Sassafras, Norfolk, and related series. Originally low in plant nutrients, 3 centuries of cropping have in many instances brought about severe depletion of both major and minor fertilizer elements in this region. This loss of fertility was recognized over a century ago and is known to have greatly affected the fortunes of many of the great estates of that time. George Washington was very much interested in this "first American soil problem," and a little west of this area, it is said that Jefferson spent his last years in poverty, fighting a losing fight in attempting to restore the fertility of his fields. It is little wonder that this section produced Edmund Ruffin and John Binns, early Virginians who made important contributions to our knowledge of the value of lime, fertilizers, and crop rotation, in preventing soil exhaustion.

That this pioneer work in soil fertility has borne fruit is attested to by the fact that many of the old fields are still in production, and in many instances are now subjected to the most intensive type of farming, that of truck crop production. In the rejuvenation and maintenance of these once depleted soils, commercial fertilizers have played a vital part. Climate and geographical location make this area ideal in many respects for the production of some 20 vegetable crops. Of these, tomatoes are one of the more important.

Approximately 25,000 acres of tomatoes are planted annually in eastern Virginia, this acreage being located chiefly in the Northern Neck section, including the Counties of Westmoreland, Northumberland, Richmond, and Lancaster, and in the two Eastern Shore counties of Accomac and Northampton. All but a small percentage of this crop goes to the canning industry. Prices are low, usually less than $10 per ton. It will be readily seen that for success with such a crop, high yields are necessary.

Tested Tomato Needs

The average yield of canning tomatoes is approximately 5 tons per acre, an average which returns very little, if any, profit to the grower. In an effort to determine the cause of this low yield, the Virginia Truck Experiment Station has for the past 2 years conducted fertilizer field plat tests in Richmond County. In these tests, various fertilizer formulas, amounts, and methods of application were compared. The tests for 1939 were conducted on two farms, both located on Sassafras fine sandy loam soils.

The fields were laid out in 44 plats, each of which was 3 rows wide and 100 feet long, providing for 75 plants per plat, spaced 4 feet in each direction. Plats were separated from each other by one vacant guard row. These 44 plats allowed for 4 reapplications of each of 11 treatments. The plan of the experiment and the results obtained are presented in Table 1.

sodium nitrate, ammonium sulfate, 18% superphosphate, and high grade muriate of potash. All treatments received 20 pounds of borax per acre. The tomatoes used in the experiment were wilt-resistant Marglobe.

We had anticipated some difficulty in starting plants on the plats which received 1,000 pounds of 3-10-5 in the row before planting. However, the

TABLE 1—YIELD OF TOMATOES FOR 1939

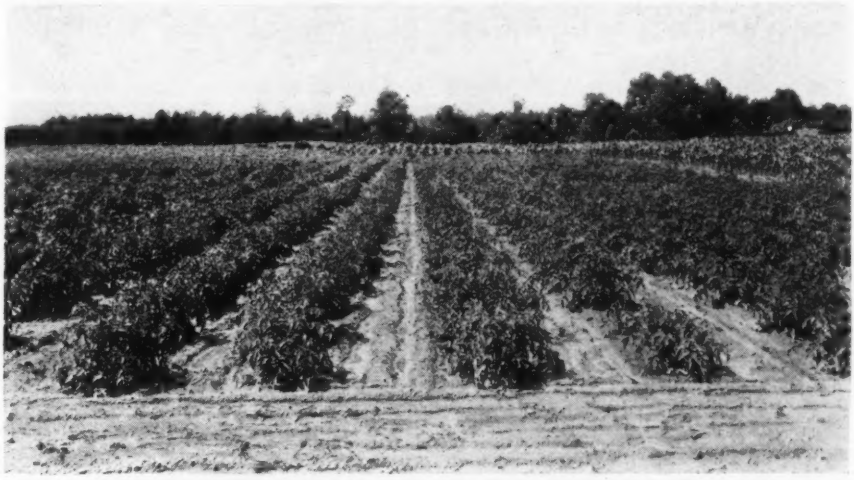
Treatment	Yield in tons per acre	
	Field 1	Field 2
1. 500 lb. 3–10–0 in row 500 lb. 3–10–0 as side dresser	6.40	14.85
2. 500 lb. 3–10–5 in row 500 lb. 3–10–5 as side dresser	10.24	17.45
3. 500 lb. 3–10–10 in row 500 lb. 3–10–10 as side dresser	10.44	19.17
4. 100 lb. K_2O preapplied broadcast 500 lb. 3–10–0 in row 500 lb. 3–10–0 as side dresser	9.75	17.47
5. 100 lb. K_2O preapplied broadcast 500 lb. 3–10–5 in row 500 lb. 3–10–5 as side dresser	12.32	18.33
6. 100 lb. K_2O preapplied broadcast 500 lb. 3–10–10 in row 500 lb. 3–10–10 as side dresser	12.53	16.97
7. 100 lb. P_2O_5 from superphosphate in row 1,000 lb. 3–0–5 as side dresser	8.38	17.89
8. 100 lb. P_2O_5 from superphosphate in row 1,000 lb. 3–0–10 as side dresser	9.14	17.52
9. 100 lb. P_2O_5 from superphosphate in row 1,000 lb. 3–10–10 as side dresser	10.34	19.35
10. 1,000 lb. 3–10–5 All applied in row before planting	9.79	15.87
11. Farmer's application 400 lb. 3–10–5 in row before planting	9.92	14.12

The preapplied potash was broadcast on April 25. The row applications of fertilizer were made on May 9, 16 days before the plants were set out, and the fertilizer was well mixed with the soil with cultivators. The tomato plants were set out on May 25, and the side-dressing applications of fertilizer were made on July 10, when the plants were just starting to broaden out. All fertilizer was mixed from

supply of moisture was adequate, and these plants were as easily started as those which had received less fertilizer. In both of the fields, but particularly in Field 1, which evidently had a very low level of available potash, considerable difficulty was encountered in getting a stand on the plats which were fertilized with a 3-10-0 in the row. Resets were placed three or four times, and in the one field a perfect stand was

never attained. In neither field did we have any difficulty with stand on the 3-10-0 plats which had previously received the 100-pound broadcast application of K_2O.

Harvesting started on August 8, 75 days after setting, and the plants were picked twice a week during the heaviest yielding period, then later once a week, until picking was discontinued on September 29. The amount of rainfall during the picking period was excessive, and considerable loss in yield was due to rotting. The tomatoes were not graded, but the results given are of the amounts of saleable tomatoes. All tomatoes harvested and weighed were accepted by the local canners. The results obtained in 1939 are presented in Table 1.



Tomatoes growing as thriftily as these are headed for profit.

It will be noted that the yields from the farmer's application in both fields were far above the average State yield, indicating that both fields were above average fertility. However, on Field 1, preapplication of additional potash was a profitable operation. While a row application of 3-10-10 gave only a very slight increase over the 3-10-5 fertilizer, preapplication of 100 pounds of K_2O in connection with the row application of 3-10-5 gave an increase of 2 tons of tomatoes per acre over the best treatments where no potash was broadcast. This increase of 2 tons per acre was worth, at the average price of about $9 per ton, more than $18 per acre, certainly a profitable return for an operation which cost for potash and labor no more than $5 per acre.

No other treatments gave any increase over the basic 3-10-5 application. In general, those plats which received superphosphate in the row, and all of their nitrogen and potash in the side-dressing application, yielded slightly less than the corresponding treatments where the same amount of nutrients had been applied, but with all nutrients divided evenly between the before-planting application and the side-dressing application. This indicates that nitrogen and potash are essential to the early growth of tomatoes and should be applied before setting on soils of low fertility.

The results from Field 2 are somewhat different from those of Field 1. Being in a higher state of fertility, preapplication of potash gave no response on this field. Likewise, there was no decrease in yield in those plats receiving superphosphate in the row and all

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Richer Soils Make Richer Communities

By C. B. Williams

North Carolina State College of Agriculture, Raleigh, North Carolina

IN a purely rural community, there can hardly be a shadow of doubt in the mind of any experienced rural observer that the first essential in the development of the farm home and rural church, as well as in the betterment of school and health conditions, is that of making farming more profitable. To do this, one of the most important factors is increased acreage yields of crops at a minimum outlay for labor and money, consistent with good cultivation. Even in normal times, the number of poor homes, inadequate churches, and poorly equipped schools is far too large, mainly because the farms surrounding them are producing too poorly, thereby affording their owners only small incomes on which to support their families and to contribute to the support of these rural institutions.

During the past few years, in visits to different sections of the South, the writer has been forcibly struck with the marked correlation which exists between the moderately and highly productive soils of farms on the one hand and the excellent character of the farm homes and their surroundings, the splendid schools and churches in the neighborhood, the healthiness of the farm families, and the educational qualifications of the people generally on the other. In close proximity to such areas it has not been uncommon to find other less productive areas, sparsely settled, with the people poorly nourished and living in humble homes without beautification and with their children afforded little opportunity to enjoy social, religious, and educational advantages.

Under normal conditions, the underlying conditions most largely responsible for these differences is not generally hard to find. To a large extent, it is directly associated with differences in the productiveness of the soils. Does not this, then, unmistakably point to the fact that one of the greatest and most fundamental necessities of successful farming is that of securing and applying information that will aid in the maintenance of the productive soils and in the economic building up of those not inherently productive?

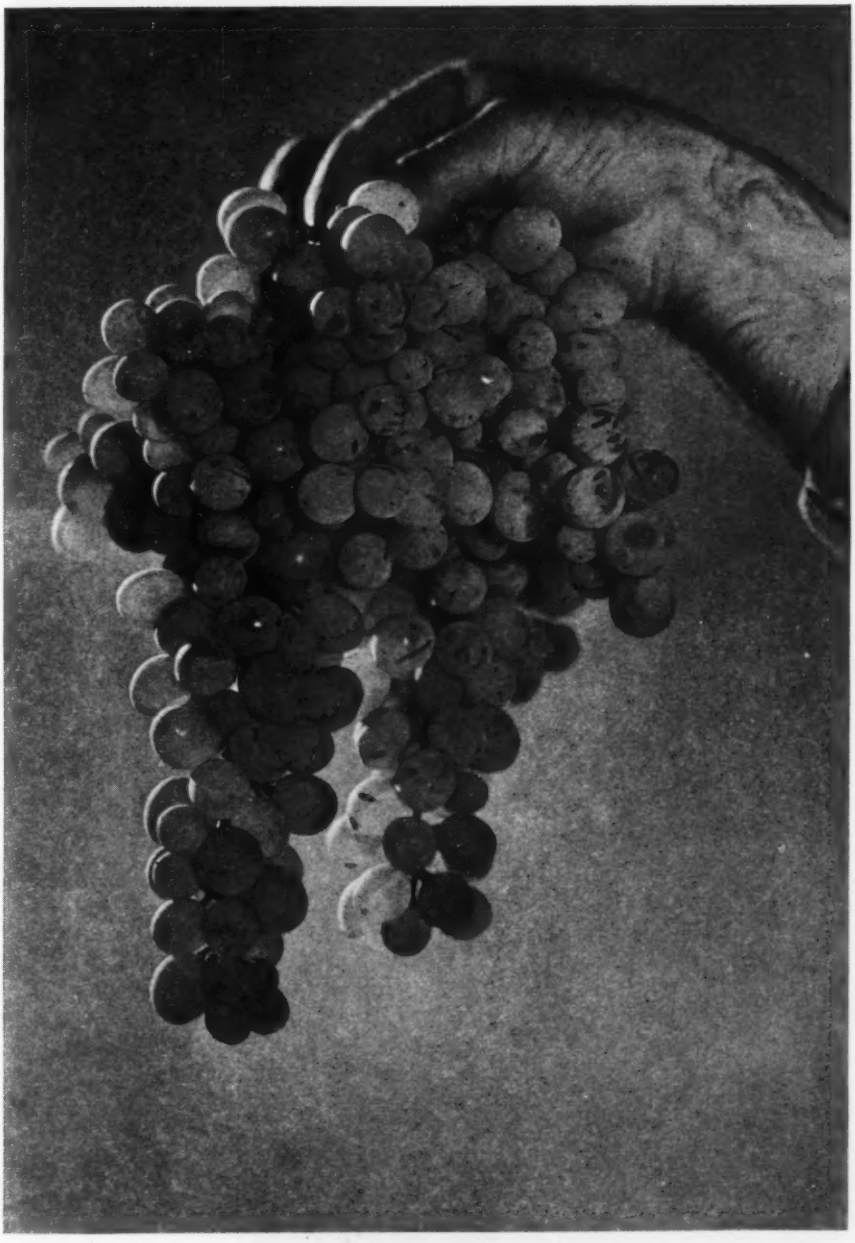
High Yields Necessary

No community, State, or nation dependent upon its agriculture, and most of them are to a great extent, can prosper when its agricultural soils are not economically productive, and they cannot be economically productive unless the yields are moderately high. History will amply bear out this observation. Even in times of depression, other things being equal, those communities having good soils will usually feel it least and will be able to weather periods of diminished returns without any great amount of hardships.

For most farmers, one of the most economical means of aiding in building up the productiveness of their soils is the adoption of suitable crop rotations, which suitable legumes enter and are utilized after growth in such a way as to increase the organic matter and nitrogen supplies of their soils. To do this, a goodly portion of the legumes after growth must go directly back into the

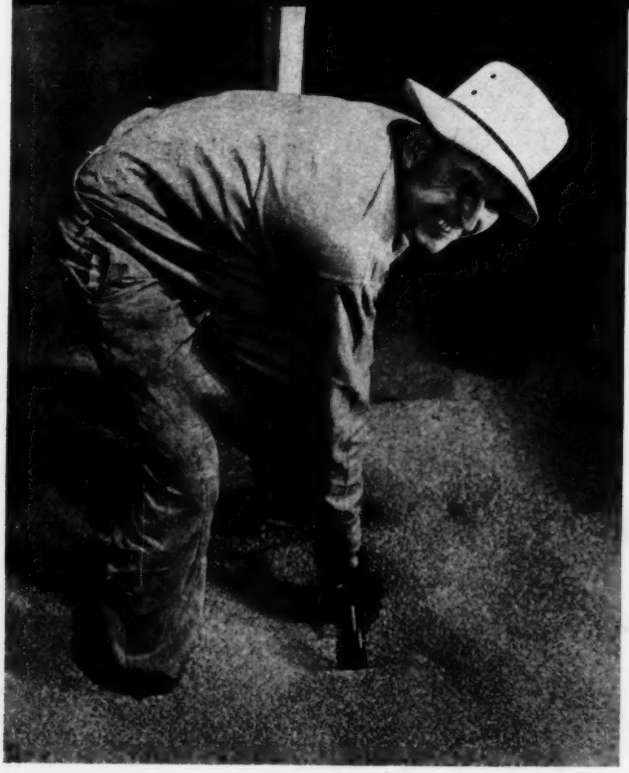
(*Turn to page* 44)

PICTORIAL



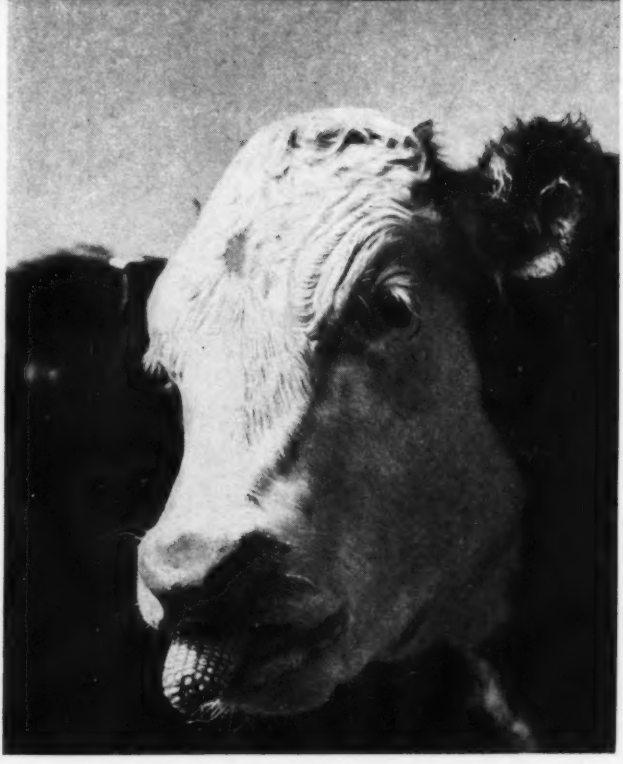
A Thanksgiving Bouquet

Above: Fair fall days take some of the pressure out of spring work.



Left: There is pleasure in this kind of digging.

Above: After-harvest check-ups and comparing of notes are beneficial.



Right: This corn is well on the way to the consumer.

Left: Aubrey Lovegrove of Kokomo, Indiana, 17-year-old winner of the State Tomato Picking Contest held at Kempton, Indiana. He scored 1,107 points to win over a field of 28 men and 1 lady contestant.

Below: A scattered field of contestants during the 4th annual Indiana State Tomato Picking Contest at Kempton.

The Editors Talk

Premature Fertilization

Used as a subhead in an article appearing in a recent issue of a Southern farm journal, the term "Premature Fertilization" caught our attention. The gist of the paragraph following was that many growers, faced with increasing their crop production, start using fertilizers and soil amendments without first considering other important factors. It is pointed out that fertilizers will not pay dividends when used on poorly drained soils that are very low in organic matter or where crop pests and disease organisms are not controlled.

Undoubtedly there are many cases of premature fertilization, with resultant disappointment in returns and prejudice against the further use of fertilizer. However, the days of guesswork on the proper and profitable use of plant food are past. So much research and experimental work has been done, the results of which are available in published form, that a high degree of dependency on the advantages of using fertilizers can be secured if growers will consult their State experiment stations and agricultural advisers. Conversant with the other factors involved in good land usage, and with the aid of quick chemical tests for measuring soil and crop requirements, these men can give growers good advice on the "why, where, what, when, and how" of fertilization.

It is true that all of the problems of plant nutrition are far from being solved. Minor elements are becoming increasingly important and much has yet to be learned about their use, particularly in plant disease control. Demonstrations and experiments with the three well-known elements, nitrogen, phosphorus, and potassium, will and should continue. Yet enough has been determined to insure their profitable use when properly balanced in amount with soil deficiencies and crop requirements. There is no need for premature fertilization.

Schools for Fertilizer Salesmen

There is a growing interest, on the part of fertilizer salesmen and representatives, in knowing more about the problems of the farmer. Now that service to the consumer has become such an important factor in any sales promotion work, the salesman who not only is well-informed on his product but who can inspire confidence by meeting the consumer on common ground and offering some worth-while advisory assistance is the one who will not fear competition. To furnish this common ground, as well as to disseminate new information on fertilizer usage, more and more agricultural colleges and experiment stations are holding fertilizer conferences, which are in effect schools for salesmen.

During the winter there will be several of these schools held throughout the

country. While usually of only one or two days duration, these days are packed with "learning." A typical program is that of the Southern New England Conference held in Amherst, Massachusetts, last January 17 and 18. Here, those in attendance heard Professor B. A. Brown of the Connecticut Agricultural Experiment Station tell how to fertilize the potato crop in southern New England; Dr. T. E. Odland of Rhode Island State College on fertilizing the vegetable crop, Dr. W. G. Colby of Massachusetts State College on the use of fertilizers in crop rotations, and Dr. A. R. Midgley of the Vermont Experiment Station on the improvement of permanent pastures. Land use was discussed by W. A. Munson, director of agricultural extension work in Massachusetts; C. J. Brand of the National Fertilizer Association presented the national agricultural picture. Fertilizer ratios and grades recommended for New England crops were discussed by Dr. M. F. Morgan of the Connecticut Experiment Station, and Professor Ford Prince of the University of New Hampshire told how to fertilize clover and alfalfa. There was plenty of time allotted to discussion and questions.

Such conferences keep well-informed the members of the fertilizer industry who take advantage of them. There are many agriculturally trained men among these salesmen, but even they find it necessary to keep abreast of the investigational work being done by college research staffs.

In addition to the dissemination of information of ultimate benefit to the farmer, there is much of value in these conferences. Difficulties are aired and a truer understanding and cooperation between the forces working for the betterment of agriculture are fostered. It is hoped that schools for fertilizer salesmen may become a regular part of the curriculum of agricultural colleges.

Thanksgiving

Our All-American holiday has a hardier welcome in store for it this year. Events of the day have made individuals more keenly aware of their everyday blessings. Things like freedom and peace and health are more than words in songs, more than words of grace spoken over the roast turkey. They have come to life with a personal and present feeling.

This Thanksgiving will be more than a recounting of our personal benefits. A keener edge has been put upon our sympathy for the less fortunate, and our prayers are including them. We are more interested in the brotherhood of man and hopeful for its greater recognition. But recognition will not come with the wishing for it; recognition comes with a day-in and day-out living of ideals—an earnest pursuit of the principles we deem worthwhile.

Let us appreciate the abundance that is ours, but let us also find the time and the occasion to manifest in actual deeds the thoughts that come to mind as we say our Thanksgiving prayer.

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

¶ Written in "every-day" language that is readily understood by farmers is Indiana Agricultural Experiment Station Revised Circular 162, "Fertilizers for Indiana Soils and Crops," by A. T. Wiancko, G. D. Scarseth, and G. P. Walker. This important publication not only serves as a useful guide to farmers in their purchases of fertilizer, but is of material aid to fertilizer manufacturers and to salesmen and local dealers who are selling fertilizers to farmers. It briefly presents and brings up-to-date recommendations on the selection and use of fertilizers for different crops for soils of the State.

Typical of the progress made in recent years is the simplification of mixed fertilizers designated as "recommended grades." As early as 1922 and again in 1928, fertilizer manufacturers and Experiment Station Agronomists in conferences agreed to reduce the number of analyses which, in a large measure, relieved the confusion among farmers and fertilizer dealers because of the many unnecessary analyses on the market. Another conference of Midwestern agronomists and fertilizer manufacturers, held in December 1938, resulted in a further revision of the desirable analyses in the light of much more complete information regarding the soil needs and crop responses. The list of mixed fertilizers agreed upon for Indiana consists of the following:

0-8-24	2-8-16	3-9-18
0-10-20	2-12-6	3-12-12
0-12-12	2-14-4	4-10-6
0-14-6	2-16-8	10-6-4
0-20-20		

By selecting from the recommended high grade fertilizers listed above, farmers will get better values in what they buy, the selection of proper grades will be greatly simplified, and better results will be secured by all concerned, the authors state. Brief paragraphs comprising the text give pertinent information on soil acidity and liming, methods of applying fertilizer, and maintaining soil fertility. Appropriate charts tabulate the fertilizers and amounts recommended for the various crops under different soil conditions, amounts of plant food used by different crops, and some pH values, and soil and crop relationships.

"How to Fertilize Cotton in Louisiana," Agr. Ext. Serv., University, La., Ext. Cir. 183, Mar. 1939, R. A. Wasson.

"Fertilizers and Manures," Agr. Exp. Sta., State College, Miss., Mimeo. 17, Aug. 1939, H. O. West.

"Phosphate in Utah," Agr. Exp. Sta., Logan, Utah, Bul. 290, Aug. 1939, J. Stewart Williams.

"Phosphorus in Wyoming Pasture, Hay, and Other Feeds," Agr. Exp. Sta., Laramie, Wyo., Bul. 233, June 1939, O. C. McCreary.

Soils

¶ The wide scope of activities represented by the U.S.D.A. Bureau of Chemistry and Soils is ascertained in the index of publications by the chemist, his associates, and assistants, given in volume I (mimeograph report) "Index of Publications," prepared by H. P. Holman, et al, under the direction of W. W. Skinner. This index comprises 8,428 articles and publications produced over a period of 75 years from 1862 to 1936, inclusive, with a list of titles and authors. It is felt that an index of

this nature was needed to intelligently evaluate the current program of work. Though the literature was surveyed with painstaking care, it is quite probable that not all publications have been listed, especially such as appeared in earlier years or in obscure journals. Dr. Skinner explains that "results of our work have appeared in the Proceedings of many of the learned societies of this country and abroad, and in a wide range of scientific, technical, trade, and popular journals. If he who runs has read, there should be a widespread knowledge of the development of agricultural chemistry in this country."

"Soil Management for Kentucky," Agr. Ext. Serv., Lexington, Ky., Cir. 272, May 1939, George Roberts.

"Supplemental Irrigation in Missouri," Agr. Exp. Sta., Columbia, Mo., Bul. 410, Aug. 1939, R. P. Beasley.

"Field Mechanics of Terracing," Agr. Ext. Serv., Knoxville, Tenn., Pub. 227, Aug. 1939, G. E. Martin.

"Terrace Outlet Waterways," Agr. Ext. Serv., Knoxville, Tenn., Pub. 228, Sept. 1939, G. E. Martin.

"Farming Peat Lands in Wisconsin," Agr. Exp. Sta., Madison, Wis., Sp. Bul., Feb. 1939, A. R. Albert.

"Soils Survey, Decatur County, Georgia," U. S. D. A., Washington, D. C., Series 1933, No. 24, Mar. 1939, A. H. Hasty, Earl D. Fowler, R. T. Avon Burke, W. H. Buckhannan, Z. C. Foster, and G. L. Fuller.

"Soil Survey, Mason County, Michigan," U. S. D. A., Washington, D. C., Series 1936, No. 1, April 1939, C. H. Wonser, J. O. Veatch, and W. J. DeBoer.

"Soil Survey, Orleans County, New York," U. S. D. A., Washington, D. C., Series 1932, No. 34, March 1939, Robert Wildermuth, Arthur E. Taylor, H. R. Adams, John Lamb, Jr., and D. G. Greenleaf.

"Soil Survey, Alfalfa County, Oklahoma," U. S. D. A., Washington, D. C., Series 1933, No. 23, Feb. 1939, A. W. Goke, C. A. Hollopeter, and R. E. Penn.

"Soil Survey, Armstrong County, Pennsylvania," U. S. D. A., Washington, D. C., Series 1932, No. 35, March 1939, R. T. Avon Burke, S. O. Perkins, L. J. Yohn, O. C. Lewis, C. H. Atkinson, and L. A. Brown.

"Soil Survey, Kent and Washington Counties, Rhode Island," U. S. D. A., Washington, D. C., Series 1934, No. 9, Feb. 1939, R. C. Roberts, H. C. Knoblauch, S. V. Madison, and V. A. Hendrick.

Crops

¶ It is doubtful if any cultivated crop has ever entailed a more romantic history than that of maize or Indian corn. According to P. C. Mangelsdorf and R. G. Reeves, in Texas Agricultural Experiment Station Bulletin 574, "The Origin of Indian Corn and Its Relatives," Indian corn is grown in every State of this country and every suitable agricultural region of the globe. In fact, a crop of corn is maturing somewhere in the world every month of the year. This interesting monograph, while different in many respects from hypotheses previously considered, contains a wealth of information on the old and new theories of the origin and spread of maize and related plants, and its relation to culture and civilizations. This account embraces important conclusions of almost every student who has ever approached the problem of piecing together the many puzzles of the Old World genera, and the clearer picture of American genera of related grasses.

"Forty-ninth Annual Report for the Year Ending June 30, 1938," Agr. Exp. Sta., Tucson, Ariz., 1939.

"Relative Water Requirement of Arizona Range Plants," Agr. Exp. Sta., Tucson, Ariz., Tech. Bul. 80, June 15, 1939, W. G. McGinnies and Joseph F. Arnold.

"Plant Oats in 1939 for Grain Grazing & Hay," Agr. Ext. Serv., Little Rock, Ark.

"Protection of Orchards Against Frost," Agr. Ext. Serv., Berkeley, Calif., Cir. 111, April 1939, Warren R. Schoonover, F. A. Brooks, and H. B. Walker.

"The Production of Flue-cured Tobacco Seedlings in Ontario," Dominion Experimental Sub-station, Delhi, Ont., Dominion Experimental Station, Harrow, Ont., Pub. 646, Farmers' Bul. 74, July 1939, F. A. Stinson and H. F. Murwin.

"Rutabaga or Swede Turnip as a Vegetable Crop," Dom. of Can., Dept. of Agr. Exp. Farms Serv., Ottawa, Ont., Pub. 647, Cir. 142, July 1939, T. F. Ritchie.

"Colorado Farm Bulletin," Agr. Exp. Sta., Fort Collins, Colo., Vol. 1, No. 2, April-June 1939.

"Report of the Director, July 1, 1937 to June 30, 1938," Agr. Ext. Serv., Lafayette, Ind.

"Annual Report of the Extension Director for the Year Ended December 31, 1938," Agr. Ext. Serv., Lexington, Ky., Cir. 332, June 1939.

"Kentucky Fruit Notes," Agr. Exp. Sta.,

Lexington, Ky., Vol. 1, No. 11, Aug. and Sept. 1939.

"Biennial Report of the North Louisiana Experiment Station, Calhoun, Louisiana, 1937-1938," Agr. Exp. Sta., University, La., Sidney Stewart, Super.

"Potatoes and Soil Erosion," Agr. Ext. Serv., Orono, Maine, Cir. 131, Feb. 1939.

"Grass and Legume Silage," Agr. Ext. Serv., Orono, Maine, Bul. 260, April 1939, Richard F. Talbot.

"Keys to the Species of Ribes Occurring in the Great Lakes Region," Agr. Exp. Sta., East Lansing, Mich., Cir. Bul. 170, June 1939, H. T. Darlington and L. B. Culver.

"Timber Farming in the Cloquet District," Agr. Exp. Sta., University Farm, St. Paul, Minn., Bul. 343, July 1939, J. H. Allison and R. N. Cunningham.

"Mississippi Farm Research," Agr. Exp. Sta., State College, Miss., Vol. 2, No. 9, Dir. An. Rpt. Part 6, Sept. 1939.

"Farm Research, Agr. Exp. Sta., Geneva, N. Y., Vol. V, No. 4, Oct. 1, 1939.

"List of Publications," Cornell Univ. Agr. Exp. Sta., Ithaca, N. Y., Bul. 47, Revised Aug. 1939.

"Bimonthly Bulletin," Agr. Exp. Sta., Fargo, N. Dak., Vol. 11, No. 1, Sept. 1939.

"The Bimonthly Bulletin," Agr. Exp. Sta., Wooster, Ohio, Vol. XXIV, No. 200, Sept.-Oct. 1939.

"Semilleros y Viveros de Cafe," Agr. Ext. Serv., Rio Piedras, P. R., Ext. Bul. 5, Revised June 1936, Vicente Medina.

"Instrucciones Prácticas Sobre el Cultivo de la Batata," Agr. Ext. Serv., Rio Piedras, P. R., Ext. Bul. 8, Oct. 1938, E. Molinary Salés.

"Department of Agriculture–Immigration of Virginia," Richmond, Va., Bul. 374 & 375, Sept. & Oct. 1939.

"Growing Wheat in the Eastern United States," U. S. D. A., Washington, D. C., Farmers' Bul. 1817, May 1939, S. C. Salmon and J. W. Taylor.

"Permanent Fruit and Vegetable Gardens," U. S. D. A., Washington, D. C., Farmers' Bul. 1242, Revised Mar. 1939, W. R. Beattie and C. P. Close.

Economics

¶ The Pennsylvania Department of Agriculture Bulletin Vol. 22, No. 5, September-October 1939, contains some very interesting information relative to the fertilizer industry in Pennsylvania. The bulletin contains tables reporting the results of the work of the State Chemist, an estimate of the plant-food content in Pennsylvania fertilizers in 1937, and pertinent facts regarding the 1938 tonnage. During the year 1938, the agents of the Department of Agriculture in Pennsylvania selected 1,200 official samples, and of this number 1,179 samples representing 487 brands registered by 44 manufacturers were subjected to chemical analysis and classified. There were 360 brands, 894 samples of complete fertilizers, there were 12 brands and 15 samples of ground bone fertilizer, 62 brands and 180 samples of superphosphate fertilizer, 12 brands and 18 samples of lime-phosphate fertilizer, 33 brands and 64 analyses of rock and potash fertilizers, and 8 brands and 8 analyses of miscellaneous fertilizers.

Licenses were issued to 116 manufacturers during the year 1938. These licenses represented, 1,033 brands, of which 798 were mixed fertilizers and 238 were for the sale of materials.

According to the 1938 applications for registration, there were 370,162 tons of all classes of fertilizer sold during the year 1937. This compared with 318,330 tons sold in 1936. The 1937 tonnage was composed of 255,457 tons of complete fertilizers, 2,281 tons of ground bone fertilizers, 87,891 tons of superphosphate fertilizers, 6,831 tons of lime-phosphate fertilizers, 152 tons of ammoniated phosphate fertilizers, and 10,499 tons of rock and potash fertilizers. Miscellaneous fertilizers included such items as tankage, dried blood, nitrate of soda, potash salts, etc., representing a total of 7,051 tons. It is estimated that the 1937 tonnage supplied 8,125 tons of nitrogen, 44,582 tons of available phosphoric acid, and 16,681 tons of water-soluble potash, or 69,388 tons of plant food.

The average retail selling price for complete fertilizers in 1938 was $30.62 per ton, as compared to $29.26 in 1937. This may not mean, however, that the price of fertilizers was increased, because, according to the data contained in the bulletin, there was an increase in the plant-food content of fertilizers in Pennsylvania of .5 of a unit between 1936 and 1937. If this increase continued through 1938, it would be expected that the average selling price would be higher.

¶ According to Bulletin No. 577 of the Texas Agricultural Experiment Station, "Commercial Fertilizers in 1938-39 and Their Uses," sales of fertilizers in Texas in the 1938-39 season amounted to 93,115 tons. This compares with 79,640 tons in 1937-38, and 84,936 tons in 1936-37. Texas, however, has never recovered the loss of fertilizer tonnage during the depression. The previous high for sales in the State was 187,215 tons in 1928-29. This dropped to 30,843 tons in 1932-33 and has recovered to the present tonnage since. The six leading grades sold in the State in the order of their tonnage are as follows: 4-8-4, 4-12-4, 4-8-6, 6-8-4, 6-10-7, and 6-12-6. These grades represent 59,463 tons of the total sales, or 64 per cent. In addition to the data regarding the tonnages and analyses of fertilizers, the bulletin contains much interesting information relative to the cost of plant food in the various fertilizers, the average composition, the price of the different grades, and general information with respect to fertilizers, such as how to apply fertilizers, how much to apply in side-dressing, and fertilizers for various parts of the State and for various crops, etc.

"To Fertilizing Materials Registrants," St. Dept. of Agr., Sacramento, Calif., Announcement 40, Sept. 15, 1939.

"Classified Sales of Commercial Fertilizers as Reported to Date for the Quarter Ended June 30, 1939," St. Dept. of Agr., Sacramento, Calif., Mimeo., Sept. 15, 1939.

"Economics of Sugar Beet Production in Colorado," Agr. Exp. Sta., Fort Collins, Colo., Bul. 453, June 1939, R. T. Burdick.

"Consumption of Fertilizer Materials by Counties of Florida for Month of August, 1939, as Reported by Manufacturers," Fer. Stat. Div., Bu. of Inspec., Tallahassee, Fla., Nathan Mayo, Com.

"Consumption of Mixed Fertilizers by Counties of Florida for Month of August, 1939, as Reported by Manufacturers," Fer. Stat. Div., Bu. of Inspec., Tallahassee, Fla., Nathan Mayo.

"Commercial Fertilizers Inspected and Analyzed in the State of Georgia Year 1938," Section 1: Individual Samples Commercial Fertilizers, Section 11: Commercial Fertilizers by Brands," St. Dept. of Agr., Atlanta, Ga., Serial 124, Jan. 1939, C. A. Gillespie.

"Georgia Tonnage Based on Tag Sales by Companies from July 1, 1938 to June 30, 1939 Inclusive," St. Dept. of Agr., Atlanta, Ga., Mimeo.

"Markets and Market Preferences for Idaho Potatoes," Agr. Exp. Sta., Moscow, Idaho, Bul. 231, June 1939, O. L. Mimms and George W. Woodbury.

"Illinois Farm Economics," Agr. Ext. Serv., Urbana, Ill., No. 52, Sept. 1939.

"The Southern Illinois Tree Fruit Industry, Summary of a Survey," Agr. Exp. Sta., Urbana, Ill., AE1164, May 1939, V. A. Ekstrom.

"Indiana Crops and Livestock," Agr. Exp. Sta., West Lafayette, Ind., No. 168, Sept. 1, 1939.

"Differences in Iowa Farms and Their Significance in the Planning of Agricultural Programs," Agr. Exp. Sta., Ames, Iowa, Res. Bul. 260, June 1939, Walter W. Wilcox and Norman V. Strand.

"Tabulation Showing Tonnage of Fertilizer Shipped in Each Parish from September 1, 1938 to August 31, 1939," St. Dept. of Agr., Baton Rouge, La., Mimeo.

"Crop Report for Michigan, September 1939," St. Dept. of Agr., Lansing, Mich., Verne H. Church and Cecil J. Borum.

"Farm Business Notes," Agr. Ext. Serv., University Farm, St. Paul, Minn., No. 201, Sept. 1939.

"Landlord-tenant Relationships in Renting Missouri Farms," Agr. Exp. Sta., Columbia, Mo., Bul. 409, Aug. 1939, John F. Timmons.

"Rural Social Areas in Missouri," Agr. Exp. Sta., Columbia, Mo., Res. Bul. 305, Aug. 1939, C. E. Lively and C. L. Gregory.

"The Agricultural Conservation Program in New Hampshire," Agr. Exp. Sta., Durham, N. H., Sta. Bul. 314, June 1939, Harry C. Woodworth, Victor H. Smith, and Emil Rauchenstein.

"Current Farm Economics," Agr. Exp. Sta., Stillwater, Okla., Series 49, Vol. 12, No. 4, Aug. 1939.

"Estudio Economico de 270 Fincas de Tabaco en Puerto Rico, 1936-37," Agr. Exp. Sta., Rio Piedras, P. R., Bul. 50, June 1939, R. Colon Torres.

"The Probable Economic Effect of a Homestead Exemption Act on Public Revenues in South Carolina," Agr. Exp. Sta., Clemson, S. C., Bul. 323, Aug. 1939, G. H. Aull.

"Fertilizer Analyses Recommended for South Carolina," Agr. Exp. Sta., Clemson, S. C., H. P. Cooper, Mimeo.

"Types of Farming in Tennessee," Agr. Exp. Sta., Knoxville, Tenn., Bul. 169, April 1939, B. H. Luebke, S. W. Atkins, C. E. Allred, and W. J. Roth.

"Business Analysis of Farms in Utah County, Utah," Agr. Exp. Sta., Logan, Utah, Bul. 289, Aug. 1939, Walter U. Fuhriman and W. Preston Thomas.

"The Drought Farmer Adjusts to the West," Agr. Exp. Sta., Pullman, Wash., Series in Rural Population, No. 4, Bul. 378, July 1939, Richard Wakefield and Paul H. Landis.

Foreign and International Agriculture

To supply information on agricultural research in other countries, titles and a few descriptive remarks of principal articles in the two magazines "Die Ernährung der Pflanze," published in Berlin, Germany, and "La Potasse," published in Mulhouse, France, are given here. Due to space limitation, only articles of general fundamental interest are given, although both magazines contain other articles of local interest and abstracts of outstanding articles in other publications.

Die Ernährung der Pflanze, August 1939, Vol. 35, No. 8

The Beneficial Effect of Potash on the Yields of Flax Straw and Seed and on the Quantity and Quality of the Fiber. *By H. Ulbricht, Dresden, Germany.*

Flax was grown on a moderately fertile soil following rye cut for hay. The rye received 36 pounds of nitrogen, 54 pounds of phosphoric acid, and 72 and 108 pounds of potash on the completely fertilized plots with "single" and "higher" potash applications. In addition, some plots were given fertilization lacking potash, and others lacking phosphoric acid. After harvesting, the straw was retted, scutched, stripped, and hackled. The relative yields of straw and seed, and per cent fiber in the straw were as follows:

	NP	NPK	NPK	NK
Straw	100	116.0	126.5	122.6
Seed	100	112.6	148.9	142.3
% Fiber in straw	17.0	20.4	20.1	18.4

The highest yield of straw and seed was thus with the complete fertilizer highest in potash. In addition to the increased yield of straw, there was an increased percentage of fiber in the straw from the complete fertilizer. Tensile strength of the fiber also was highest with these treatments. The straw from the plots without potash had to be scutched much longer, thus causing a loss of fiber. The fiber from this flax also was darker in color.

The stalks of the plants were sampled after 2 months' growth, and shortly before harvesting, in order to study cross sections of them under the microscope. Marked differences in the appearance of the vascular bundles, and of the cells making up these bundles could be seen. It is these long tube-like parts of the plant that make up the fiber. When potash was lacking in the fertilizer, the plants produced bundles that were smaller than when the plants had plenty of potash. There were also fewer bundles, and they were irregular and poorly developed. The walls of the individual cells were thinner. When phosphorus was lacking, the bundles, while large, had a tendency to be divided into segments, and were less compact and weaker than in the case of the complete fertilizer.

Symptoms of Potassium and Magnesium Deficiencies on Various Forest Trees and the Effects of Fertilization with Potassium Chloride and Sulphate of Potash-Magnesia on Their Growth. *By W. Jessen, Münden, Germany.*

Pine, spruce, and larch seeds were planted in sand in pots, with different fertilizer treatments. Muriate of potash, in addition to nitrogen and phosphoric acid, increased the growth and weight of the 6-months old seedlings. Magnesium in the fertilizer did not have an influence on the weight of the seedlings, but increased the magnesium and potassium contents, and decreased the calcium contents. When potash was omitted from the fertilization, rather characteristic deficiency symptoms appeared. These were noticeable on the

pine and spruce plants sooner than on the larch. On pine, the older needles became a pale, dull blue-green, with many of the needles having reddish-brown tips. When nitrogen was deficient, the whole needle became brown. The spruce needles became brown or reddish-violet, with brown spotting over the entire area. The larch needles became bright yellow and chlorotic, especially the older ones. The author states that nitrogen and potash deficiency symptoms are difficult to differentiate on this plant.

Magnesium deficiency symptoms on spruce are characterized by a yellowish discoloration of the younger needles, while on pine the needles were chlorotic, with red and brown tips. The lack of this nutrient did not show any apparent signs on larch.

CAN SODIUM PARTIALLY OR WHOLLY SUBSTITUTE FOR POTASSIUM IN PLANT AND ANIMAL LIFE? *By G. Rohde, Berlin, Germany.*

The author has made an exhaustive literature review of the subject giving consideration to the relationships of the two elements to each other, to other elements, and to physiological activities in plants and animals. For many years, there has been a general belief that sodium could replace potassium to some extent in the nutrition of plants, especially if the latter is present in limited amounts. To some extent the chemical similarities are responsible for this belief, with apparent confirmation from experiments where increased yields sometimes resulted from the use of sodium compounds.

By means of a careful analysis of experimental work reported from many parts of the world, and particularly by comparing the relative effects of the elements on certain activities in the plant, the author comes to the conclusion that in most cases at least, sodium cannot substitute for potassium in nutrition. Instead of the two elements being complementary, they are in reality antagonistic in their effects. A number of examples of this antagonism are cited. The similarity of the action of calcium and sodium, and the dissimilarity of potassium in plants in the formation of oxalic acid is shown. The antagonistic relationship of calcium and potassium is well known, and in plants sodium appears to act similarly to calcium. It is brought out that sodium tends to drive potassium out of a tissue, the potassium going to another part of the plant, enriching that part of the plant in this nutrient, and giving the impression that the sodium favored the absorption of potassium by the plant. Where sodium has caused a higher total removal of potassium by the plant, this is considered as possibly due to a more vigorous root development, thus increasing the foraging powers of the plant.

A number of other examples are given showing the dissimilarity of action of the two elements in both plant and animal life, all leading to the general conclusion that the two elements are antagonistic in action and cannot substitute for each other in their functions in living cells. Sodium does not increase the effectiveness of potassium in cells, but decreases it, the author states.

INVESTIGATIONS INTO THE LIFE-HISTORY AND CONTROL OF THE CAUSATIVE ORGANISM OF STEM-ROT OF TOMATOES.

Stem-rot of tomatoes caused by Didymella lycopersici is difficult to combat, especially in the field. Ordinary spray methods are not effective and prevention of spreading of the organism is one of the most helpful ways of keeping the disease down. The stakes used for supporting the vines should be disinfected each year with 1 per cent formaldehyde, and resistant strains of plants should be planted. Since the organism seems to thrive in soils well supplied with organic matter, the use of manure should be reduced where the disease is established.

FERTILIZER PRACTICES ON FLOWERS AND ORNAMENTAL PLANTS IN GERMANY. *By E. Maurer, Berlin, Germany.*

The author gives a summary of common practices followed by flower growers in Germany. There is a marked tendency to increase the use of mineral fertilizers over organic manures, although the latter are not by any means being fully replaced. Many plants absorb nutrients in the ratio of 1-2 parts nitrogen, one part phosphoric acid, and 3-4 parts of potash. Many ornamental plants prefer an acid medium of growth, so physiologically acid fertilizers should be used for them. Roses, however, generally prefer a medium nearer the neutral point, and usually should be limed. During the season growers will apply about 10 pounds of nitrogen, 2 pounds of phosphoric acid, and 20 pounds of potash per 100 square yards to roses. On carnations, about 8 pounds of nitrogen and 4 pounds each of phosphoric acid and potash are used.

THE INFLUENCE OF CULTURAL METHODS AND GROWING CONDITIONS ON THE YIELD OF TUBERS AND STARCH AS WELL AS ON THE COOKING QUALITY OF POTATOES. *By Elsner-Trierenberg, Germany.*

In this summary of a series of experiments, it is shown that variety has a great influence on yield and starch content of tubers. Fertilization has relatively little influence on starch content, but materially influences tuber yield, and in this way, also total yield per acre of starch. The starch content varied from 11.4% to 21.3% with different varieties within 1 year. Weather, diseases, and other factors also influence starch content. With conditions favorable to tuber production, starch content is likely to be lower than with conditions not so favorable. When potash was omitted from the fertilizer, the plants died much earlier than those receiving a complete fertilizer, with consequent decreased yield. Judged on the basis of taste the tubers lacking potash also were much poorer in quality than when other nutrients were omitted, or all supplied. These potatoes also were poor in appearance after cooking.

Minor Elements and Miner Methods

By R. E. Stephenson

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A CENTURY of cropping has been sufficient to seriously deplete the fertility of many once-good soils, even where there has been little or no erosion. In recognition of this fertility depletion, loss of humus, nitrogen, and available phosphorus was first given attention. Then on the older soils potassium depletion was recognized. And finally a depletion of the available supply of minor elements has come to the general attention.

Grain farming has received the blame, and probably justly, for much fertility exhaustion. Single crop farming, whether small grain, corn, cotton, or some other crop, is not conducive to a high state of fertility. Fifty crops of grain averaging 20 bushels to the acre remove in the grain and straw N-P-K equivalent to 8 tons of high grade complete fertilizer for each acre. Some lands according to owners have produced more than this amount of grain.

In western Oregon some of this 50-year grain land, which had ceased to produce profitable crops, has been set to orchards. Trees have consequently made unsatisfactory growth (sometimes about half size) and are not producing profitably.

Not only grain but legume crops may exhaust the soil. A 4-ton yield of alfalfa is a moderate crop. On good lands alfalfa may be grown continuously for 20 years or more and then reseeded for another like period, or as long as the crop produces satisfactorily. Removal of an average of 4 tons of alfalfa hay a year for only 20 years takes off the equivalent of 2½ tons of 16 per cent superphosphate and 3½ tons of muriate of potash per acre. Of course if the crop were fed on the land or the manure returned, the fertility loss would not be as great. However there are many fields and plenty of evidence that serious losses do occur only too frequently.

Plant Foods Depleted

Depletion of the virgin supply of such elements as sulfur, manganese, zinc, copper, and boron has sometimes been as severe, but less frequently observed than for the standard N-P-K. The 20-year production of alfalfa may remove sulfur equivalent to 2,500 pounds of land plaster an acre, or boron equivalent to 100 pounds of borax an acre. The figure for boron seems small until it is observed that some soils may not contain this amount of total boron in the plowed depth. Similar statements hold for zinc, copper, cobalt, nickel, and others of the less abundant elements.

In short, many have been following the methods of the miner, with this difference, the miner usually is conscious of the limitations of his available supply of ore. Mining methods depend upon as nearly complete removal as possible, in contrast to the methods of good husbandry, which should imply conservation and wise use of the soil resources. Mining methods cannot be applied successfully to the handling of soils, as many have already come to realize. With proper methods and sufficient attention to the husbandry of soil resources, in contrast to most mines which are soon exhausted, soils may be kept productive indefinitely. This principle is the essence of the story "Farmers of Forty Centuries," by F. H. King. These old soils have been kept productive for 4,000 years by meticulous care to return everything possible to the land.

Causes of Fertility Loss

There are four major causes for loss of fertility from cultivated fields, soil erosion, leaching, waste of manure, and sale of crops or animals. Erosion takes both fertility and the soil. A skin-deep layer of rich topsoil may remove as much plant food as is required to produce one crop. Erosion losses can be prevented. Leaching, which washes soluble plant nutrients through the soil and into the drainage, may take as much of some nutrients as the crops. The leaching process is responsible also for the development of soil acidity, leaving behind toxins and a condition generally unfavorable to cropping. Much of the leaching can be prevented by proper management. Careless methods in conserving and using farm manure have resulted in an enormous and largely unnecessary waste of fertility. The best farmers now have these losses largely under control. Assuming that all general practices are good, some fertility must be removed whenever any crop or animal is marketed. Sale of animals removes relatively less fertility than sale of crops. Sale of animal products such as cream, butter, and eggs removes still less fertility. A ton of butter may remove scarcely 35 cents worth of plant nutrients. Few are as favorably situated as the dairy farmer for maintaining a fertile soil.

The major means of fertility renewal are three. The growing of legumes transfers nitrogen from the air to the soil through activity of the nitrogen-

fixing bacteria. Some non-symbiotic organisms function in the same way. More legumes and more encouragement for the right kind of soil micro-organisms are needed. The purchase of feeds for livestock fed on the farm is a fruitful means of improving the fertility of soils. Purchased feeds, such as grain and mill feeds often used to balance home-grown roughage, are rich in both the major and the minor elements. The purchase of feed is a sound fertility practice for the purchaser but hard on the seller. Last but not least, the purchase of commercial fertilizers becomes necessary for the indefinite maintenance of soil fertility. Purchased feeds may only transfer fertility from one farm to another. The purchase of fertilizer brings fertility often originating in minerals buried deep in the earth. Through the efforts of the fertilizer industry, nitrate and potash beds, gypsum and phosphate deposits are drawn upon to enrich a depleted surface soil. Both more fertilizer and more intelligent use to provide proper kinds, amounts, and methods of application are needed.

Fertilizer Must Be Available

A depleted soil is often low in its supply of the available form of several elements. Good yields will not follow until all of the deficiencies are corrected. Under such conditions the so-called "minor" elements, whether zinc, copper, boron, or something else, are just as "major" in importance as the standard N-P-K. Partial correction of the deficiency only throws the nutrition of the plant out of balance and exaggerates the uncorrected deficiency.

During the summer of 1936, the author and C. E. Schuster cooperatively were attempting to grow sunflowers under greenhouse conditions as indicator plants to detect soil deficiencies. Certain soils, particularly in the deeper horizons, refused to grow satisfactory plants, even when fertilized with the usual N-P-K treatment. Always at a definite stage of growth certain deficiency symptoms developed. Unaware that any soils in Oregon were deficient in boron, but impressed with the futility of attempting to grow normal plants without some additional treatment, a solution of boric acid supplementing the supposedly complete fertilization was added to the plants. To our surprise the former symptoms of malnutrition were corrected, and normal plants were produced. Boron on these soils was of major importance to plant nutrition. This discovery has been verified many times since.

Regardless of what mineral nutrients are supplied, the addition of compost or other humus materials usually improves plant nutrition. In nature soils and the virgin vegetation develop together. Fertility improves with the gradual accumulation of humus, until the highest type of vegetation and the maximum production of which the soil is capable result. The soil is the product of its environment and the forces and processes acting upon it. Nature's vegetation represents a major soil-forming influence resulting finally in topsoils very different in properties and productive capacity from the original minerals and rocks out of which the soil was formed.

Tillage and cropping by man interfere with nature's equilibrium. The process of gradually building the suppy of humus is reversed, and accelerated humus depletion follows. Plants are themselves miners of the soil, in the sense that they extract from the mass of rock and mineral debris those elements important to plant growth. Plants are capable of absorbing nutrient from very dilute solutions, thus enabling the poorest soils to support some plant growth. Due to the power of the plant to obtain nutrient under adverse conditions, the plant material may contain a higher percentage of important nutrient elements than the soil itself. Thus the average of 33 plant materials commonly returning to the soil to make humus was 0.262 per cent of sulfur. By contrast the average sulfur content of 22 American soils was 0.055 per cent, or only about a fifth as much. The average sulfur content of 43 west-

ern soils where sulfur deficiency may occur was only 0.02 per cent, or less than a twelfth as much as for the plant materials. A similar relationship holds for phosphorus, with 0.057 per cent for 22 typical soils, and 0.103 per cent as the average for 368 grasses. The legumes are higher in phosphorus, as indicated by data from the Oklahoma Station, showing an average of 0.18 per cent for 335 legumes.

In the processes of converting plant materials to humus in the soil, certain elements are still further concentrated in the organic fraction. Results from various sources indicate that a third to half the total phosphorus in the surface soil may be in organic form. Minnesota work indicates that the duff on the forest floor is nearly 75 per cent richer in sulfur on a percentage basis than the freshly fallen leaves. This enrichment undoubtedly is due to decomposition of carbohydrates or other non-sulfur-bearing organic materials. Starting with plant materials averaging perhaps less than 2 per cent nitrogen, humus is formed containing 5 to 6 per cent nitrogen. Thus growth of plants and the return of their residues to the soil to make humus serves to absorb, concentrate, and conserve important plant nutrients.

Provide Active Humus

In any soil-building program, provision for humus renewal must be given a prominent place. Active humus in the soil is essential for those processes which liberate nutrients for plant growth. Humus materials carrying both major and minor elements provide for the complete nutrition of plants. Active humus is not only richer in many important nutrients than the pieces of stone and minerals making up the major soil mass, but organic matter decomposes more readily than the rather resistant mineral matter. The inactive residue of humus in depleted soils of course becomes less and less effective in the liberation of nutrient materials. Finally the "run-down" humus-depleted soil becomes lifeless and structureless, and sometimes nearly sterile. Some such soils will scarcely more than germinate seeds.

An adequate fertilizer program must therefore adapt fertilizer usage to humus renewal practices. The soil-building legumes and sod crops must receive adequate fertilization. Farm manure must be supplemented with commercial fertilizers, making both more effective. Light application of manure to cover more acres, with moderate use of additional commercial fertilizer is a sound practice that will improve more acres more effectively. The weaknesses of manure may be strengthened with fertilizer and vice versa. In this day of hormones, auxins, and sometimes evasive but essential growth stimulants, humus and manures take on added significance. Stable manure undoubtedly contains indol-acetic acid, skatol-butyric acid, and other similar products that have been recognized as important growth stimulants. Minor elements and compounds needed by plants in scarcely detectable trace amounts have assumed major importance in the production of crops.

The worst kind of soil mining results from production and sale of cash crops, and particularly those crops with a low acre-value that do not justify a liberal fertilization. Sale of cash crops of high acre-value is usually followed by a comprehensive and effective fertilizer practice. Even under these conditions there is always the danger that the supply of some overlooked, but non-the-less important element may be exhausted. The use of many kinds of fertilizer, including compost, farm manure, and plant residues for soil improvement, helps to provide for a balanced plant nutrition. Farmers of the future will be compelled to "ease up" on their soil-mining practices and to give more attention to "putting back" into the soil, not only the standard N-P-K, but also the "minor" elements that have now assumed major importance.

Indiana's 1939 Potato Champion

AUGUST MONHAUT, R. R. 1, Mishawaka, Indiana, is Hoosierdom's 1939 Potato Club Champion, with a yield of 526 bushels on his acre of Chippewa potatoes. The acre was a part of a 9-acre field planted the first week of May. "The way the season turned out," stated Mr. Monhaut, "it was this early planting that played an important part in my high yield." He grossed 4,500 bushels on the 9 acres.

Last year Mr. Monhaut had the field in potatoes, but a wet season ruined his stand. Since then he has added drainage to the field. Last year he applied 400 pounds of 0-10-25 fertilizer per acre and believes that it played a part in this year's crop. This year he applied 750 pounds of 2-12-12 per acre and supplemented this with 16 tons of manure from his dairy barn. On a part of the 9 acres, he also applied 375 pounds of potash per acre before planting and sprayed his potatoes five times. His total yield of marketable potatoes was 4,500 bushels.

Mr. Monhaut farms 148 acres, 28 acres of it being muck ground. He has a dairy herd of 15 cows, 2 registered Belgian mares, and 5 brood sows produce the pigs which he fattens. He is considered an excellent farmer, very exacting in his methods.

August Monhaut with a basket of winners.

Handbook of Fertilizers

AN easily interpreted reference manual covering a wide scope of subjects on commercial fertilizers and liming materials is the authoritative Handbook of Fertilizers, now in its third edition, by Dr. A. F. Gustafson, Professor of Soil Technology, Cornell University (Orange Judd Publishing Company, New York, $1.75). Written in a simple, clear style, this reasonably priced little book contains up-to-date information on sources, make-up, effects, and use of fertilizers. It is especially applicable for farmers, florists, teachers, county agents, and others desiring a general treatise on these subjects.

The text centers around 10 chapters: Requirements for Plant Growth; Nitrogenous Fertilizer Materials; Phosphatic Fertilizer Materials; Potash Fertilizer Materials; Effects of Fertilizers on Crops and Soils; Factory-Mixed Fertilizers; Home-Mixing of Fertilizers; Purchase and Use of Fertilizers; Liming in Relation to Fertilizer Practice; and Organic Matter in Relation to Fertilizer Practice and Use. There are also 26 appropriate illustrations in the book.

Fertilizing Tomatoes in Eastern Virginia

(*From page* 21)

nitrogen and potash as a side-dressing. The soil in this case apparently contained sufficient nitrogen and potash to take care of the early growth of the tomatoes. However, the highest yields were obtained on those plots receiving the 3-10-10 mixture, treatments 3 and 9, indicating that the extra potash was again profitable.

One must conclude from these studies that the oldest agricultural soils in Virginia are still capable of producing very satisfactory yields of canning tomatoes, provided the grower utilizes available knowledge concerning proper cultural methods. Of prime importance is the question of lime. Today, as in the time of Edmund Ruffin, many of these soils need lime. Where needed, lime must be applied, for fertilizer used on very acid soils cannot be effective. When acidity is corrected by liming, and a fair organic-matter content is maintained through the ploughing under of green manure crops, these soils respond readily to commercial fertilizers.

On soils having a high fertility level, from 400 to 600 pounds per acre of a 3-12-6 or 5-10-10 fertilizer should be applied before setting time, and a similar application made as a side-dressing from 4 to 6 weeks after setting. On soils of a low fertility level, 200 pounds to the acre of muriate of potash should be applied broadcast approximately 3 weeks before setting, 400 to 600 pounds of 3-12-6 several days before setting, and another 400 to 600 pounds of 3-12-6 as a side-dressing 4 to 6 weeks after the plants are set.

Ingenuity Employed in Official Research

(*From page* 14)

The frequent taking of samples from the bales and patching up the covering as the bales go through the marketing process has always been a drag on the industry. The problem of automatic gin-bale sampling while the bales are being formed at the gin is now partially solved and several applications for patents have been filed. Automatic sampling at the gin, together with permanent identification, offers unique and far-reaching advantages to American cotton in world markets and to southern agriculture.

But while this bale goes forward to market, other cotton is taken from the Department's experimental ginning laboratories for use in many kinds of studies toward further improvement. Utmost patience is required in the work on the small samples—in the study of such phases as the fibers, the waste, the color, the spinning qualities, and the ultimate yarns and fabrics. In all of this coordinated work precise instruments are a necessity.

A method for determining the tensile strength of raw cotton more rapidly by an X-ray technique than is possible by the usual mechanical methods has been worked out in the cotton-testing laboratory. Conversion tables for making interpretations are being developed. A photoelectric photometer has been specially designed and constructed for reading the X-ray diffraction patterns. This instrument was essential in the adaptation of the X-ray technique for the measurement of raw cotton strength but it has other important applications, too. A patent is being applied for.

Foreign matter in cotton is another age-long detriment. For close study of both cotton and foreign matter, this material must be adequately removed from a sample. The more that can be

practically removed at the gin without detriment to the fibers the better. So a pair of Government workers invent a foreign-matter fractionator, and it is patented. With this, the nature and extent of the foreign matter in seed cotton can be rather easily determined; the efficiency of the different cleaning and extracting units (individually, in combination, and with various settings) can be established; and the best equipment and operation can be recommended for different types and conditions of cotton. Another develops a cotton-seed delinter that gets the last bit of lint from the seed and provides a mechanical means for reclaiming the tip ends of the seed for use in the weight determinations of seed. A punch device especially designed for measuring the size of seed by ascertaining the seed-coat area had already provided a more accurate measure than the weight, which had previously been used as an index to size.

Other pieces of special laboratory equipment are an improved cotton-fiber sorting machine that permits measuring fiber length with a relatively high degree of accuracy, ease, and speed; a device for a bundle-fiber test of fiber strength; and so on.

Classing the Cotton

It is a temptation to look at all of the inventions or improvements and see just how they advance the work, but we move on to other phases nearer to the practical classing of the cotton.

In the classing rooms in Washington, D. C., the "Supreme Court of the industry" operates—the Appeal Board of Review Examiners here settles disputes as to classifications. The practical forms of the cotton standards are made here for sale throughout the world. Important studies relating to classing are carried out. These rooms are equipped with special skylights and are subjected to practical or complete air conditioning and humidification.

Apparatus for measuring gradations in color, developed and patented by a color technologist in these laboratories, is useful in standardization work with cotton, with hay, and with many other agricultural and industrial commodities. We think of cotton as pure white—the snow of southern summers. But as it comes to market its color really ranges from creamy whites to flat whites, and from blue-stained through gray, spotted, yellow tinged, to deep-yellow stained. These differences affect both utility and prices, and it is commonly believed that these colors are stable. With this patented apparatus for measuring gradations in color in a practical way and the techniques developed for using it, continuing intensive studies are made of changes in cotton colors and the conditions or combinations of conditions that are likely to cause these changes.

Perfect Accuracy Sought

Elimination of the personal equation from grading is always important. An instrument for automatically scanning the surface of a cotton sample by means of a photoelectric cell hook-up is well along in the process of development in the color measurements laboratory. An application for a patent will soon be made.

Studies instrumental in bringing about artificial daylight conditions in classing room and laboratory are attracting wide attention from other scientists. To get this set of conditions experiments have been made with "color temperatures" of lamp and filter combinations; with special glass for the "skylight" to be placed under them, considering its selectivity as to wavelength and transmission; with diffusion possibilities; with the best color and brightness to be used for background; and with other problems too highly specialized for profitable review here. Applications following this work have already been made to several other industrial as well as agricultural problems. Not only cotton grading, but grading of linters, hay, tobacco, fruits and vegetables, furs, textiles, paints, and

plastics, are dependent upon daylight for accurate results. The manager of a hotel that was to be used by a convention of bedding manufacturers saw the Department's "daylight" installation and then provided ingenious booths at his hotel with a modified form of artificial daylighting so that grading and inspection could be carried on accurately within the convention rooms.

But the cotton people hold no monopoly among Government agricultural workers on the making of inventions, for they are to be found here and there throughout the entire Department. Men who are connected with the standardization and inspection of grain have ten public-service patents to their credit. Many are exceedingly practical. It is authoritatively estimated that these standardization patents alone have saved the people, year after year, millions of dollars in the marketing of their crops. In the case of grain, for instance, the patents have enabled the inspection service to grade in such a way as to establish and maintain confidence in the accuracy of the grain dealt in, on the part of farmers, bankers, and domestic and foreign buyers. This confidence means better prices for better qualities, freer trade, and better feeling all along the marketing line. With other crops the inventions help to keep off the markets the undesirable products that cannot pay expenses, they save time in marketing procedures, and they aid in adjusting prices to qualities.

Renovation Makes Pastures Profitable

(*From page* 18)

able success, but it was this trial that yielded the first concrete evidence that sweet clover and alfalfa repelled the egg-laying June beetle. This discovery of the Wisconsin agronomists and entomologists has since become the basis for a most effective means of white grub control.

The June beetles whose eggs hatch into white grubs prefer to do their egg-laying where sweet clover and alfalfa do not abound. The large flight of June beetles in 1929 deposited enough eggs in the unrenovated bluegrass to produce white grubs at the destructive rate of 220,000 per acre, according to counts made in 1930. In the renovated portion immediately adjacent, only 20,000 white grubs per acre were found, and such a rate of infestation is quite harmless to the pasture grasses.

The duration of the benefits of this pasture renovation of 1929 are shown by the data gathered in subsequent years on white grub and weed control. Heavy flights of June beetles occurred in 1929, 1932, 1935, and 1938. Comparing the number of grubs in the renovated and unrenovated portions of this pasture in the years immediately after the beetle flights, the populations of grubs were reduced by the renovation of 1929 as follows:

1930	90.9%
1933	87.2%
1936	79.2%
1939	70.4%

Moreover, the weed populations in the renovated bluegrass were 93.7% less in 1937, 90% less in 1938, and 78.5% less in 1939 than in the adjacent area of unrenovated bluegrass.

In 1934 and 1935, Graber renovated portions of from 1 to 33 acres of 30 thinly sodded and weedy bluegrass pastures widely distributed in southern and western Wisconsin, using biennial white-blossomed sweet clover, alfalfa, and medium red clover. In 1936, a year when white grubs were extremely destructive, there were, by actual count, from 91% to 98% less grubs on the renovated portions of these pastures

than prevailed in the unrenovated portions immediately adjacent. In 1937, all weeds including ragweeds and horseweeds, which were the dominant species, were 86% less on the renovated portions.

Not only did such benefits prevail, but the sods thickened and grasses were much more productive on the renovated areas, and this situation still holds in 1939. Even where some of the renovations were excessively grazed, such benefits persisted, but not nearly to the extent in which they prevailed under moderate and regulated grazing. Renovation is not very costly when measured in terms of its long-time benefits.

Florida Studies Celery Plant-food Needs

(*From page* 12)

sufficient. If pink rot or other disease organisms make it desirable to remove strippings from the field for sanitation purposes, 3,000 pounds per acre are advisable.

Boron deficiency, causing cracked stem, has not been noted in the Everglades. Of the other trace elements, manganese is essential, and Dr. Beckenbach recommends 100 pounds of manganese sulfate per acre to raw lands previous to their first cropping, or to lands growing celery for their first time if no manganese has been added for previous crops. For succeeding years he says 25 pounds per acre should suffice. Manganese sulfate, 83 per cent, can be added to bordeaux sprays which are applied weekly to celery for early blight control. Four pounds per 50 gallons are suggested for the first 3 or 4 weekly sprays, if manganese has not been applied in the fertilizer.

The requirement of celery for zinc is not large, but Dr. Beckenbach says the addition of 25 pounds of zinc sulfate per acre in the fertilizer the first year serves as an inexpensive insurance against zinc deficiency. In subsequent years 10 to 15 pounds per acre should be sufficient, or 2 pounds of 89 per cent zinc sulfate may be added to each 50 gallons of bordeaux for the first few sprayings.

Since copper is the normal base for bordeaux sprays, which are used regularly on celery, the addition of this element in the fertilizer is not necessary, except perhaps the first year celery is grown on the land. Dr. Beckenbach recommends 100 pounds per acre of some snow-form bluestone for this application.

With the plants spaced 4 inches apart in 30-inch rows, it was found that the most desirable fertilizer from the standpoint of yields also gave most desirable stalk sizes. Medium sized stalks are most popular on the market, followed by a fair sprinkling of larger and smaller sizes. The recommended fertilizer applications, 3-6-12 at the rate of 2,000 pounds per acre where strippings are left on the land and 3,000 pounds where they are removed, gave desirable stalk size distribution in the average year.

The use of a mole for drainage in the Everglades gave Dr. J. R. Neller and Dr. R. V. Allison of the Experiment Station an idea for the development of a machine for disinfecting the muck soil against nematodes. An iron pipe, smaller than the mole, however, is attached to the base of a cutter-bar foot and is propelled through the muck soil at a determined depth. It has a pipe or tube attached to it and leading from the tank containing the chemical. As the machine progresses the chemical is sprayed into the soil, forms a gas, and kills the nematodes.

They used both carbon bisulfide and chloropicrin in the machine with satisfactory results. The chloropicrin was found to be more effective than the bisulfide in controlling nematodes under these conditions.

Richer Soils Make Richer Communities

(*From page* 22)

soil. No one can remove them from the land and have their growth benefit the soils in a substantial and permanent way.

Concurrently with the use of proper rotations, it will be necessary to supply crops grown on most soils with materials carrying available phosphoric acid, potash, nitrogen and in some cases lime from commercial sources in sufficient amounts and in proper proportions for each crop grown on each soil type as may be needed. Commercial fertilizers of the right kinds wisely purchased and properly used will usually pay and pay well, especially with major crops. The manure from crops fed on the farm should be carefully saved and put back into the soils of the farm in such a manner as to sustain a minimum loss and at least cost. If this is done, the analysis of the fertilizers necessary to purchase may be somewhat modified and cheapened for the areas to which the manure is applied. It should be remembered, however, that the areas on most farms to which manure can be applied will usually be small.

Again, after the crops have been produced, steps must be taken by growers to see that the very best returns possible are obtained from them. When fairly good profits above cost of production are secured, then and not until then will it be possible for individual farmers to do what they should and will do for the betterment of their homes and for the enrichment of the life of the communities in which they live.

It Pays to Balance Your Soil Fertility

(*From page* 8)

During the past 7 years a total of 313 demonstrations have been conducted on farms throughout southern, central, and north-central Wisconsin. These demonstrations have been set up for the most part on the silt and clay loam soils, and fertilizers have been applied at rates of from 150 to 250 pounds per acre to the grain crop at the time of seeding down to legumes. Records show that in 285 out of the 313 demonstrations there has been a profitable return from some one of the fertilizer treatments. In many cases comparisons were made between the 20% superphosphate and mixtures carrying potash: We have charged the full cost of the fertilizer against the increase in the yield of grain. This is hardly fair since the residual carry-over on seedings of alfalfa and clover or other

YIELDS OF BARLEY, WILLIAM WAGNER FARM, MIDDLETON, WISCONSIN

Treatment	Yield Bu.	Increase Bu.	Value of inc. grain + straw*	Cost of fertilizer	Net profit
No fertilizer	43.7	....	.....	.....	.....
0–20–0 at 200#	53.2	9.5	$5.56	$3.00	$2.56
0–20–10	66.5	22.8	13.23	2.63	10.60
0–20–20	71.1	27.4	16.19	3.45	12.74

* Barley valued at 55c per bushel; straw at $3 per ton.

crops will frequently show benefits and increases in yield for 1 and even 2 years following the initial application.

Tabulated below is a summary giving the average yields of all grain plots (oats and barley) for the past 7 years where, in 134 of the above 313 demonstrations, direct comparisons were made between superphosphate and phosphate-potash combinations (mostly 0-20-0 vs. 0-20-10).

TABLE 1—AVERAGE FOR 134 GRAIN DEMONSTRATIONS (7 YEARS INCLUDING 1939)

Treatment	Average rate per acre	Average yields	Increase straw yields	Value of increase*
0–20–0	200 lb.	46.1	448 lb.	$5.75
0–20–10	200	49.8	641	7.98
Check	...	36.4	...	.....

* Grain valued at 50c per bushel; straw at $4 per ton.

It will be observed that there have been average increases of 9.7 bushels of grain where superphosphate was used, but where 10% of potash was added the increase jumped up to 13.4 bushels. Figuring the average value of barley and oats included in these average yields at 50¢ per bushel and the straw at $4 per ton, we have a total of $5.75 profit for superphosphate and $7.98 for the 0-20-10.

In 37 cases out of the 134 demonstrations recorded above, where a direct comparison was made between superphosphate and 0-20-10, we were able to check yields on the hay crop the year following the initial application. Tabulated below are the increases in hay yields. (The value of the increase in yields of grain has been added to the value of increases in yield of hay to arrive at the total net profit per acre.)

Here we have evidence that the residual benefit carried over to the hay crop does add substantially to the profit from fertilizer treatment. In fact, in these 37 plots where it was possible to check yields of the hay on those fields where fertilizer had previously been used on grain, there was a total net profit amounting to $7.98 for the superphosphate and $11.78 where 10% of potash was added to the phosphate.

In checking over the results of these fertilizer demonstrations conducted during the past 7 years, together with information obtained from experiment station data on our sub-stations at Hancock and Marshfield, we are recommending more and more potash for grain and legume seedings—even on the heavier soils of Wisconsin. For many years we have known that the sandy soils of Wisconsin were low in potash, and, of course, we have accepted without question the need for potash on the

TABLE 2—RESIDUAL CARRY-OVER BENEFIT TO HAY CROP—37 PLOTS

Treatment	Average hay yields	Average hay increases	Value*	Total value increases hay, grain, straw	Cost of fertilizer	Net profit
Check	3,289	.....	.....	.....	.....	.....
0–20–0	3,977	788	$4.73	$10.48	$2.50	$7.98
0–20–10	4,523	1,234	7.40	15.38	3.60	11.78

* Hay valued at $12 per ton.

low bottom peat, muck, and black silt and clay loams. Now, however, we are finding that even on many of the heavier silt and clay loam upland soils potash is needed for maximum returns.

Even in the case of small grains we find that some potash added to phosphate has, in a high percentage of cases, produced the greatest increase in yield and has made the largest profit. From the above data it is very evident that the response of the alfalfa or clover hay crop the year following is much greater on those plots receiving potash. This is what we would expect, since legumes are heavy feeders on potash.

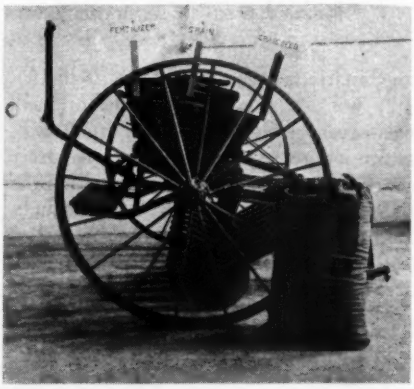
Fertilizer Recommendations

We are, therefore, recommending quite generally such mixtures as 0-20-10 for the silt and clay loam soils, the 0-20-20 for the sandier soils where small grain and seedings are being made. Of course, on the thinner, lighter colored silt and sandy loams, no doubt mixtures carrying some nitrogen should be used. Here I would recommend such mixtures as the 3-18-9 or 3-12-12 at rates up to 300 pounds per acre.

We are urging farmers to have their soils tested. Most of the county agents in Wisconsin are now equipped to do this work, and not only do they have well-equipped laboratories, but WPA chemists have been hired to do this work under a project sponsored by the Soils Department, College of Agriculture, and approved by the Works Projects Administration in Washington.

It is my sincere belief that based on the results of these chemical tests, together with some knowledge of the soil type requirements, crop history of the field from which the samples were taken, together with information as to what crop is to be grown, the county agent, Smith-Hughes teacher of Vocational Agriculture, or soils specialist will be able to make his recommendations with a high degree of accuracy. Farmers more and more are availing themselves of this service, which is resulting not only in the more general use of lime and fertilizers so badly needed, but in a more intelligent use of these fertilizing materials.

For best results fertilizers for small grain should be applied with a combination fertilizer grain drill. For years I have contended that if it pays to use fertilizer, it will pay a farmer to buy the proper machinery with which to apply it. Better results are secured on the silt and clay loam soils where the fertilizers are applied with a combination fertilizer drill at the time of seeding. Furthermore, the use of the combination drill will permit the sowing of grain, fertilizer, and grass seed all in one operation. However, the combination drill is not absolutely essential to securing results with commercial fertilizers. Broadcast applications can be made with the regular hopper type sower or even the end-gate spreader. Where the end-gate trailer type of spreader is used, it is desirable to mix in some limestone or soil with the fertilizer in order to bulk it up, thus insuring more uniform distribution. Many farmers, of course, still apply their fertilizers by hand.



The combination fertilizer grain drill sows grain, fertilizer, and grass seed all in one operation. Attachments can be secured for most makes of drills. Best results are secured where fertilizer is drilled in with the grain at the time of seeding.

The application of from 200 to 300 pounds per acre of commercial fertilizer at the time of seeding down to clover and alfalfa and repeated every rotation will gradually build up the fertility of the farm as a whole. Larger yields of

grain and bigger crops of alfalfa and clover will add to the home-grown feed supply, will cut feed costs, and increase the possible livestock carrying capacity of the farm. More livestock will make more manure, which, if properly handled and returned to the fields, will gradually build up the level of fertility of the farm. The sum total of all these benefits is greater net income.

Abundance

(*From page* 5)

covery systems than to let folks drift onto the pavements or see them harvest the "grapes of wrath." I take no stand herein but only raise again the old issue as a wish-bone to tug at over the Thanksgiving interval.

If the personal income test is used to determine whether it pays to be provident in caring for natural soil resources on farms, we have latest proof that it does from the Ohio experiment station. They testify in a series of check tests run with the help of the Federal Soil Conservation Service that farmers doing the best job of keeping up proper soil fertility balance were realizing the best income.

These data conclusively show that good farm income need not be secured at the expense of the soil. Moreover this calculation was not made with the inclusion of factors which would levy a credit or a loss on soil balance as additional points in real estate valuations. If soil resources could be measured for such an inventory, it would add still more to the actual income laid away by thrifty operators.

I OFTEN think the time is coming when actual known fertility on a given farm will play a greater part in setting the sales price on it than it has in the past. It would in this way allow the farmer a more definite key to his basic assets stored in the soil, as well as for the evidences of his good management seen above ground.

Abundance to many people signifies a great plenty of tangible commodities and financial assets, but surely I would be negligent in my duty as a commentator to let it go at that and quit. We may "talk turkey" at Thanksgiving, but it is not the sum total of our conversation.

Many sound and hopeful folks believe that if agriculture were put on a profitable basis within ordinary terms, so that nominal wealth and comforts were possessed by all country dwellers, we need not argue with them or plead with them to adopt the finer things of life. It is their honest contention that a high standard of living and patronage of the arts by the many is entirely a question of income, and that it is therefore wasted effort to teach cultural and esthetic movements among a sullen and broken people.

Knowing something of this by frequent observation, I cannot entirely accept such doctrine. I am more inclined to adopt the theory that we find evidence of the finer instincts and motives regardless of farm incomes, and that many well-to-do individuals sadly lack sensibility to the gracious and precious elements of life not connected with profit and loss.

I know that you can easily supply the examples to sustain me. So I mention only two, both of them encountered afield within the past fortnight.

At a harvest festival among a line of sturdy drivers was an old acquaintance of mine with a chunky team. I had not seen him for a decade and noted how gray he had become and how bent and wrinkled. He mentioned the rapidity of passing years before I had time to switch the subject. He said he was getting old and the farm work was not so easy to perform, yet it was stated without bitterness or complaint, but rather

with a dubious grin. Just as I was about to step aside he touched my arm and pointed with a ragged mitten, sweeping an arc around the autumn horizon. I followed his gesture with my eyes and beheld the scarlet, gold, and dazzling purple of the brilliantly colored hardwood forest, flecked with the vivid greens of conifers, ranks and rows around the circling hills, shot with the rays of the morning sun.

"Have you ever seen anything prettier than that?" he asked, his eager eyes aglow and his voice intense with meaning. "I have lived in this valley for over forty years, and I think the woods have the finest coloring this fall that I have ever seen, even when I had good eyesight. I took my gun out yesterday for a shooting spell, but I couldn't hit anything just fer gawpin' at the trees. You know, it isn't so bad fer agriculture after all, if a man sort of looks around once in awhile. I think maybe we don't use our eyes enough, and our mouths too much."

THEN again at another farm I saw splendid out-buildings, modern fencing, the latest corn harvesters and combines, sleek livestock, and wonderful yields on amply fertilized fields. I learned that the owner had once had an airship as well as other expensive gadgets and contrivances. He was a genius at mechanics. His earning power had been well above that of the township because of his alertness and great vitality. Yet staring you in the face like a spectre of grim portent was a shabby dwelling, heaped about with odds and ends of wire and broken iron, the yard littered with cobs and cans. I caught just one fleeting glimpse of the slavey he called his wife, haggard, thin, and pitiful, but he never took me in to see his household. He preferred to talk big about the prospects for plenty and the prices to be paid for hogs.

To me this indicates that success and income never can be the index to the richness of rural life.

And lastly, it occurs to all of us more or less, that no state of abundance is worth a celebration as long as we just gobble it up and take no heed of ways and means to distribute that abundance —both material and spiritual.

When we were young there was not so much said about domestic starvation and malnutrition, but the woeful tales and subscription drives were issued in behalf of China and India. It strikes me that back there when we actually had less sum total of grub to spare, we had fewer cases of want and more surplus to ship abroad for famine relief.

AND now when the granaries are bursting on the farms, and metal bins are filled with Federal grain, we must keep a constant lookout for the welfare of those who cannot earn enough to boil the family pot.

They tell us also that this will be a permanent picture. They inform us that our productiveness from the soil has outdistanced our productiveness elsewhere, at least on an exchange basis. They claim that the farmer must pile on more manure and mortgages and create greater efficiency amid general deficiency.

But this is the economist's viewpoint, and most of us forget that a little during the rush of harvest time. We come in from the barn and get a whiff of doughnuts and chicken stew, rub on a few quarts of horse liniment to loosen the joints, and defy the gloom bugs to sting us into dreary melancholy.

Especially so when somebody turns on the ranting radio and we learn that another bomb has burst abroad. Then we tuck in our napkins and dig into the provender before us, hoping that the land we till can hold out another season, regardless of the surplus bogey or the wavering price.

And that's where I wish to leave you, half way between the fifth and sixth courses, turning your hopeful hearts toward Christmas and a long winter of resignation. We shall continue to be able to observe Thanksgiving over and over, as long as we plow good land on the west side of the statue of Liberty.

KNEW THE BUSINESS

An old negro man passed before a notice recently posted by the sheriff and laboriously spelled out the large letters: "THIEF WANTED!"

"Reckon Ah better take it," he muttered, after some study. "Cindy said not to come home widout a job, an' dey ain't nothin' else Ah can do so good. But"—gloomily—"Ah sho' does hate dem dawgs an' bird shot."

The prices of wheat and corn go up and down, but the price of wild oats will always remain the same.

First Lady: "Do you always look under the bed?"

Second Lady: "Always."

First Lady: "Do you ever find anything?"

Second Lady: "Only in old-fashioned hotels."

He had just stolen a hurried kiss.

"Don't you know any better than that?" she demanded indignantly.

"Sure!" he replied, "but they take more time."

McPherson's condition was critical and his wife, much against her will, was obliged to leave him for a short time. As she looked down at his shrunken form, her hard face softened and the tears welled from her eyes. Pulling herself together with an effort, she put on her old bonnet and returned to the bed to say goodbye. "Now remember, Angus, no extravagance. If yer feel yerself going, blow out the light."

When God created man, He gave him two ends—one to sit on and one to think with. Ever since then, man's success or failure has been dependent on the one he used most.

Diner: "Where's the menu?"

Colored Waitress: "Down de hall, three doors to de left, sir."

A fat lady stepped on the scales, not knowing they were out of order, and put in a penny. The scales went up to 57 pounds and stopped. A newsboy standing by noticed the situation. "My Gawd!" he cried. "She's hollow!"

Home is where you can scratch any place that itches.

THEY MULTIPLIED

"Say, mister," said the little fellow to a next door neighbor. "Are you the man who gave my brother a dog last week?"

"Yes."

"Well, Ma says for you to come and take them back."

A pastor of a suburban church made it a point to cordially welcome strangers after the completion of the service.

One Sunday evening a Swedish girl, employed in an aristocratic home, attended services. The pastor extended his hand and expressed the hope she would come again, adding that if she would be at home some evening during the week, he would be pleased to call.

"T'ank you," she murmured, "but Ay *have* a fella."

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